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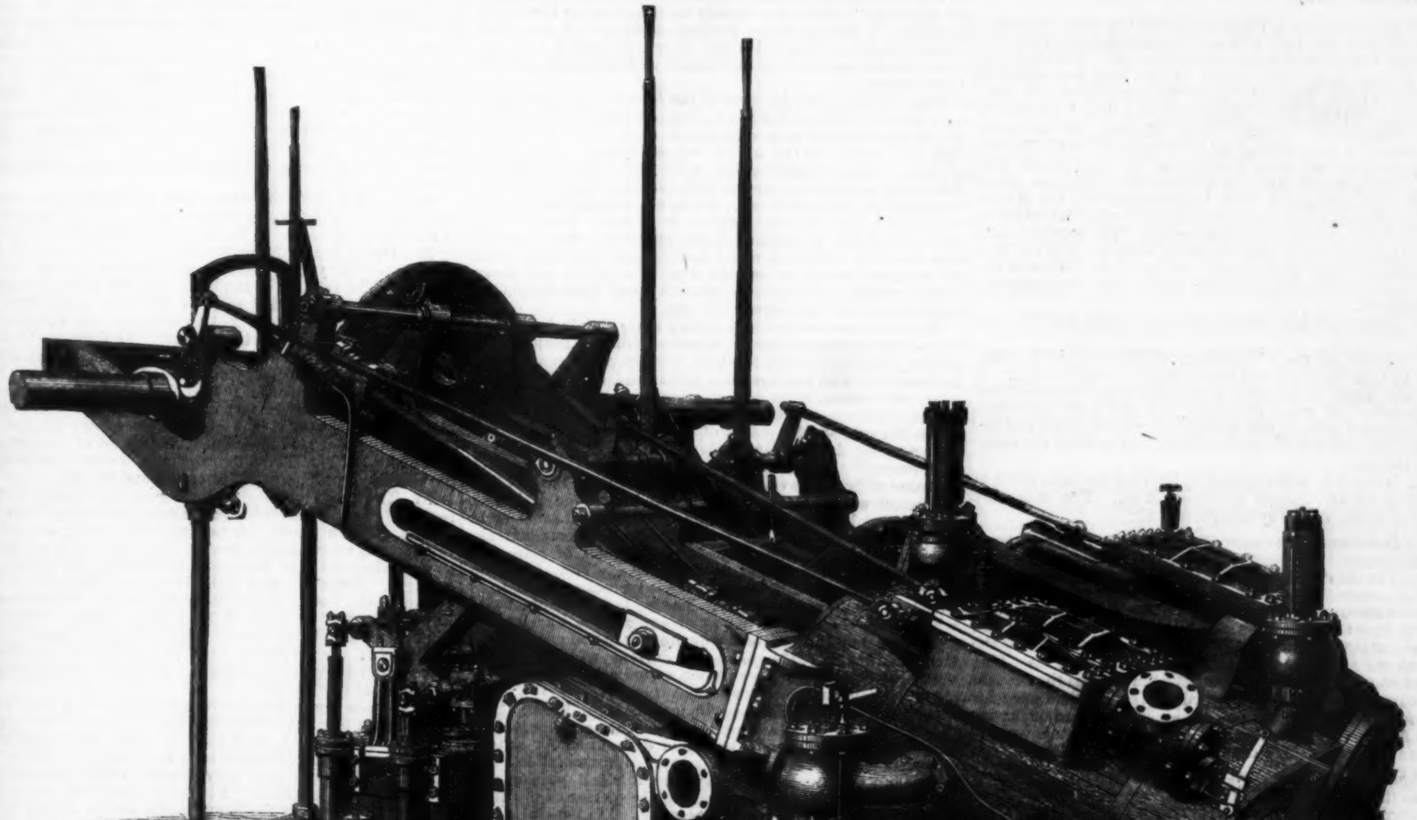
DISCONNECTING COMPOUND ENGINES.

We give a perspective view of a pair of disconnecting compound paddle engines, lately constructed by Messrs. Rankin & Blackmore, of Greenock, for the tug steamer Mount Etna, these engines being constructed on the patented system of Mr. Daniel Rankin. The tug steamer Mount Etna, which is owned by the Queenstown Towing Company, was constructed by Mr. Robert Chambers, Jr., Dumbarton, and measures 145 feet in length by 21 feet 6 inches beam, and 13 feet 6 inches in depth. Her engines shown by our illustration have high and low pressure cylinders, respectively 25 inches and 48 inches in diameter, the stroke in each case being 5 feet. The general arrangement of the engines is clearly shown by our engravings, and the design is—as will be seen—very neat and compact.

The high and low pressure engines can be worked either independently or in conjunction, the compounding of the engines not interfering with their disconnection or with the independent working of the starboard and port engines, such as is often required in the handling of a tug-boat in confined situations. When the high and low pressure engines are coupled, the high-pressure engine exhausts into an intermediate receiver and thence into the low-pressure engine and condenser, in the ordinary manner; but when they are disconnected (by means of the usual gear) the high-pressure cylinder, if working alone, exhausts through the receiver direct into the condenser; and if the pressure in the receiver exceeds 15 lb. per square inch the surplus steam passes into the atmosphere through a spring loaded valve. On the other hand, when the low-pressure cylinder is used by itself, the steam is received direct from the boilers by means of a reducing valve loaded to 10 lb., so that, in effect, it becomes an ordinary low-pressure condensing engine. The arrangement answers perfectly, and affords the advantages of compounding without impairing the handiness of engines which can be disconnected. In the case of the engines of the Mount Etna, the high-pressure cylinder has been fitted with an expansion valve, while coiled springs have been substituted for the escape and reducing valve weights which were applied to the former engines made on the same type by Messrs. Rankin & Blackmore.

The engines of the Mount Etna are supplied with steam at a pressure of 70 lb. from two horizontal tubular boilers, 10 feet 7 inches in diameter by 9 feet 4 inches long, and having four furnaces, each 37 inches in diameter. The total heating surface of the boilers is 1,900 square feet.

The Mount Etna, lately, had her trial trip, when she "ran the lights"—from the Clock to the Cumbrae Lighthouse—at the rate of 12⅛ miles per hour, the engines making 37 revolutions per minute, and indicating 500 horse power. That speed was accomplished without the slightest symptom of heating being shown. Everything worked with the greatest smoothness, notwithstanding the fact that the vessel had previously had only one short run, from Greenock to Dumbarton, to be finished by the builder. The reports which have reached us concerning the subsequent working of the Mount Etna are also most satisfactory.—*Engineering.*



DISCONNECTING COMPOUND PADDLE ENGINES.

PROGRESS OF ENGINEERING IN AMERICA.

At the recent convention of Civil Engineers, St. Louis, Mr. O. Chanute presented an interesting paper as above, from which we condense the following:

Man, at the end of the eighteenth century, was ceasing to utilize natural power in its larger and more coarse forms. From the introduction of the steam engine the engineer has become a most important agent, and his art is well defined by Telford as the director of those great natural forces that contribute to the prosperity and welfare of nations. Time had been when other countries were compelled to send to Holland for hydraulic engineers to redeem marsh lands, but by the introduction of steam these primitive masters were soon excelled in their science. In 1778 James Watts, after twenty years' struggle with a difficult problem, succeeded in originating the steam engine. It was a triumph which set men thinking, and the application of steam ensued in all its various branches. In one hundred years more was accomplished for science and mechanism than during the ten previous centuries.

Allusion was made to the wonderful growth of this country in all that pertained to engineering, and the high position the United States had attained among nations. The first subject treated of was—

Water Works.—The system of supplying water to towns by means of water reservoirs was inaugurated by Hans Anderson, at Bethlehem, Pa., the water being conveyed to a wooden reservoir through hemlock logs. The idea was followed at Morristown. The subject of application of steam to water works as first made on the Schuylkill River, at Philadelphia, was then treated; also the improvements made in pumping machines, engineers having made a gain in this respect of fifty per cent. over what was accomplished twenty years ago. Mr. Chesbrough, in laying his tunnel two miles under Lake Michigan for supplying Chicago with water, had accomplished a great engineering triumph. At present 569 towns in the United States and Canada were supplied with water reservoirs, employing 13,000 miles of pipe, 10,000 of which is of cast iron. A comparison was made between the primitive means of water supply and the present convenient means which supplies every portion of the household with hot and cold water.

Canal Engineering.—This subject was taken up and discussed briefly. There were 3,257 miles of canal in the United States, and there were improvements yet to be made in this class of propulsion. Mr. Baxter's experiments on the Erie Canal had not proven a success, and the Belgian wire-rope plan was being tried. Mr. John B. Jervis proposed to apply steam power for canal-boat propulsion, figuring a saving of over 37 per cent. by his system through increase of speed.

Railways.—The Americans were among the first to appreciate Stephenson's invention of the railroad in 1828, and were but little behind the English in utilizing it. A table taken from a manual by Mr. H. B. Poor shows that the number of miles of railroad are as follows: Europe, 90,000; United States, 86,000; balance of the world, 25,000. The percentage being: Europe, 45 per cent.; United States, 43 per cent.; balance, 12 per cent. The cost of construction in this country is $58,900 per mile, less than half that of Europe. Our engineers have introduced means that have proved cheap and efficient, and our engines pull heavier trains and make more miles in a year. The average made by an engine in Europe is 15,720 miles; in the United States, 21,900 miles per engine. While our engineers have given engines and cars greater freedom and ease of movement, the result of our sudden turns and steep grades, there are many things in engine construction, notably in boiler making, which might be utilized here with benefit. The Pennsylva-

nia Railroad—if not the best, one of the best managed railroads in the world—has been at great expense in testing improvements, and the new freight cars being tried promise to surpass all others. Our engineers have done fine work in contributing to the safety of travel; *vide* the instances of the safety platforms, power-brakes, etc., which improvements, notwithstanding the lightness of our roads, make travel here as safe as in Europe. The improvements in the matter of automatic signals are remarkable, and much more will be developed in their line. Sharp competition between lines has reduced the cost of transportation to as low rates as can be found elsewhere, and, notwithstanding the watering of stock process, a return of 3·93 is the average showing upon investments.

There are 3,500 miles of horse railways in the United States, but this means of transit is very slow. In London the problem has been solved by underground roads, but the cost in this country would be $1,500,000 per mile. New York had successfully elevated roads on girders which are sustained by iron columns. These roads cost $300,000 per mile. A decided reduction is necessary to make rapid transit utilized in large cities, and a number of prominent engineers are studying the question.

Bridges.—Engineers are necessarily the bridge builders of the country. Iron and steel are now introduced in their construction with important success and give the greatest efficiency at the smallest cost. There are now in the United States 900 miles of bridges. One-third of them are of stone and iron, the two-thirds of wood, and these latter will have to be rebuilt by our engineers with the more durable material. Reference was made to the eye-bar and rivet in the accomplishment of spans, and it was designated the great principle of success in iron bridge building. The chief defect in bridges is in the floor, and the less wood used on iron bridges the better it would be. The chief cause of accidents is by derailment of trains, and the tracks should be made as firm as possible. The question of material should not be forgotten; and I predict that the day is not far distant when steel will be produced at less cost than iron is at present by the puddling process. It has been used in the bridge at Glasgow, at St. Louis, and is being used in the East River bridge at New York,

River Improvements.—These are attracting great attention at present, and the fact is being realized that but little has been done toward river improvements as yet. Within a few years we must make river works. It has been demonstrated that, even in the Missouri River, the current can be controlled by building brush dikes. [The writer here paid a warm compliment to Capt. James B. Eads for his great achievement in constructing the jetties at a cost of $5,250,000, which answered the same purpose as the ship canal proposed, which would have cost $10,000,000. This was greeted with loud applause.] The improvement of the Mississippi by deepening its channel and narrowing its width in sundry places attracted much attention. The movable dam on the Ohio has made success in its working, and the idea was taken from the French who originated it. We will improve upon it to suit the peculiar nature and requirements of our rivers.

The government has erected 626 light-houses and 727 river lights.

The removal of the obstructions at Hell Gate in the East River by Gen. Newton was a great feat of engineering. A shaft was sunk in the solid rock, which was tunneled and honeycombed in every direction, and the 4,427 apertures were exploded with 47,900 pounds of rock powder and dynamite, unsettling three acres of rock and sinking the channel of the river.

Gen. Newton is now engaged in blowing up eight acres of a similar nature, known as Flood Rock. The holes are bored by drills driven by compressed air.

Ship Building.—The cause of decay of the maritime trade of this country is owing to the unequal competition with England in ship building and the superiority of iron over wooden vessels. The change began to take place in 1857, and notwithstanding that Robert Fulton, an American, first applied steam to navigation, and the Savannah, an American steamer, was the first to cross the ocean, our vessels, for the reasons stated, gradually disappeared from the sea. The cost of construction in this country is much less than it was ten years ago, and there is certainly a great field open for marine engineers. By use of machinery they can overcome the difference in cost of construction, and in time we can assume our proper place on the ocean.

Telegraphic Engineering.—It is very difficult to get statistics on this subject. On January 1 there were 119,042 miles of telegraph in operation, and 299,250 miles of wire, not counting the district telegraphs, fire alarms, etc., in use in the cities. The Western Union Telegraph Company sent in one year 25,070,000 messages.

The telephone, when exhibited by Prof. Bell, in 1876, was regarded as a toy. Now there are 121,000 instruments at work connecting our residences and business places so that we can talk with another miles away.

Gas Engineering.—In 1850 there were 50 gas companies in this country; to-day there are 900, with a capital of $200,000,000; and annually serving 20,000,000,000 cubic feet of gas; consuming 2,000,000 tons of coal. In competition with other illuminating agencies, they have in Europe reduced the price of gas much below what it can be made for in America. Gas furnace and other applications of gas were spoken of, and the subject of water gas touched upon. Time will show which is the cheapest of these processes.

Metallurgy.—The wonderful increase of blast furnaces in this country is notable. There are now in operation sufficient of these to turn out 6,500,000 tons of iron per year. In this we stand second, England being first, and Germany third. Our steel industry is second in the world, and in a year it will be first. The growth since 1878 has been 50 per cent., and at present enough to lay or relay 18,000 miles of railroad can be produced annually. Mining was then spoken of, and allusion was made to the enormous products of gold and silver in this country. Special reference was made to the Comstock lode, whose shaft was 3,000 feet deep, where the temperature was 103 degrees Fahrenheit, and various appliances were necessary to prevent mortality to the miners. The discovery of petroleum and its importance was spoken of, and instances were cited where, in sinking artesian wells, gas had been struck, which was utilized, the town of Fredonia, N. Y., being thus lighted by natural gas.

Agricultural Engineering.—Before this branch all others became as the dust of the valley. In the plow alone wonderful improvements had been made; although in some of the older countries of Europe the same style of implement was in use as was used when the Saviour was born. In 1850, the New York Agricultural Association made trial tests, and found in using the plow having the smallest draught a saving of $8,400,000 was the result to the country per annum. Since that time the improvements have been so steady and important that a saving of $45,000,000 is made over that time; and yet the plow of the future has not been invented, and it will probably be propelled by steam. Here is a fine field for the engineer. Other inventions, such as shellers, cultivators, etc., were alluded to, and a special tribute was paid to the most wonderful of agricultural implements, the self-binder and reaper, with which a boy could work over from 15 to 20 acres per day, the saving being estimated at one-third of the value of the entire crop, or $100,000,000.

The cotton crop of the south is now picked and worked by old methods, and here the engineer must direct his attention and study out new paths. He must break loose from the ruts he has been running in, and pay attention to these important fields—not being a promoter of schemes or a tool for the use of the magnates of Wall Street.

Upon the preservation of timber the writer pays a high compliment to Capt. Ericsson. The term civil engineer receives a much higher significance in England than with us, and the title is used in contradistinction from military engineer. In England the profession has attracted the most eminent and gifted men into its ranks, but in this country the prominent men are apt to drop back into the position of president or members of boards of public works.

We need a closer union. The vastness of our country makes it inconvenient for our members to attend the meetings. The English society is far ahead of us in membership and attendance. Our society may be improved by holding the annual meetings in some other city than New York. It should have branches in every considerable city of the country, and should attract the rising young men of the country to its ranks.

THE NEW SCANDINAVIAN DRIVING-BAND.

AT a recent meeting of the London Association of the Society of Foremen Engineers, Mr. W. Willson Cobbett read the following paper:

The introduction of the belting which forms the subject of this short paper adds a new chapter, or I will say rather an appendix, to what has already been written on the vexed question of belting *versus* gearing—a matter of no small interest to the mechanical world in general, and I hope no less so to the members of the Society of Foremen Engineers in particular.

That I hold a brief in favor of the former I need not say, and, indeed, I think that the capital advantages claimed for the transmission of power by means of belting are intensified, as it were, by the use of woven bands. Thus with gearing you have cumbrousness, noise, and vibration, disaster following upon an obstruction or breakage in the machinery, unsuitability for high speed. Such are avoided by the use of leather belting to some extent; how much more so if a belt such as this is employed, less cumbrous than leather, less weighty, working more quietly and smoothly, with more elastic stretch to sustain a sudden shock, and more suited, owing to its *extreme* pliability and light weight, to high speeds and twist arrangements.

Here you have woven belting in a more simple form than you are accustomed to see it, separated from its normal war-paint as now seen in the markets, namely, with coatings of India-rubber and gutta-percha inside and out, coatings of paint, oil-varnish, what-not—it appears as a plain piece of cotton cloth woven solid in a simple but effective way, which forms the subject of a patent of which the specification was drawn up by the late Mr. Barlow, author of the "History of Weaving." This ordinary cotton webbing, which receives its name of Scandinavian Machine Belting from the fact that the patent was first taken out in Sweden, where it is fast superseding leather, is found sufficient alone in some cases for driving purposes, as, for instance, for loom-driving. For general work some complain of the want of grip. Of course some adhesive has to be applied, and it is found desirable to give it a light coat of good Stockholm tar so as to obtain a hold on the pulley. The tar is an advantage also where there is damp. By way of experiment I am having some prepared in a different way, hoping to find good results from the process. The joint for current widths is made with ordinary leather laces, which assimilate better with the general pliability of the belt than metal fastenings. The manager of Messrs. Thomson Bonar's paper-mill, Mr. C. D. Mear, has very kindly supplied me with a tracing of an admirable joint made with bolts and dips suited for belts of this class when of great width. But I think metal less safe to use as a rule, more likely to injure this belt passing over a small pulley, and possibly wearing the surface of the drum to a greater extent. It has been suggested to me that a butt joint made as follows would be best: The ends brought together and a back piece glued on in this way (sample shown); the face of the belt is then perfectly continuous and free from jump in working. Marine glue should be used, as it dries quickly, and is unaffected by damp. Common glue would be unsuitable.

A band produced in such simple fashion, and showing itself by experiment to have greater tensile strength than leather, seems likely, from its extreme economy, to "survive" amongst the many novelties now being introduced as the "fittest." It has one of the common defects of all other woven belts, upon which I will touch presently, but not both, and bases its chief claim to distinction on the ground of the low cost of production, and I venture to say that such *is* the low cost of production for belts over three inches in width that had the tables been turned, had such belting as the Scandinavian been in universal use by some strange chance before leather, it would have been no easy matter to introduce for driving purposes so primitive a contrivance as skins of different thicknesses joined together and liable to get out of order at the seams, and to twist and curl up if cut out of certain portions of the hide, and claiming for three inches in width the price of a 10-inch cotton band. It would, I think, go through many vicissitudes before its actual value and special uses were recognized. That leather bands have great value and special uses I do not pretend to deny, notably for heavy indoor work with small pulleys at *slow* speeds. For such work there is, perhaps, "nothing like leather," but there I stop. The good old saying I have just quoted, "There is nothing like leather," carries much weight with it. It seems to be comforting, especially to leather manufacturers. My old shoemaker looks upon it as the sublimated essence of the wisdom of Solomon, and to impeach its absolute accuracy is to court contempt unutterable.

Nevertheless I maintain that for ordinary work it is better to have cheap bands such as this, made in one continuous piece, pliable, uniform in section to a nicety, running always straight and without vibration, lifting less from centrifugal force when running at high speed on account of its light weight, from the same reason running with less sag or deflection at the lower pulley when used as a vertical belt, than to use leather at its best. When not at its best, when of inferior quality, tanned by various unsatisfactory processes in imitation of oak-bark tanning, when not cut from the best part of the butt, its best friends can say little in its favor. The duration of such leather is certainly much less than that of a cotton belt.

I have spoken of the defects of leather, and it behooves me to touch also on the defects of certain woven belts. Many of these cannot be run as "crossing" or "shifting" belts—the edge gives way—also, for a similar reason, they cannot stand the constant rubbing against a guide-fork. In fact, they go to pieces. This applies especially to those made as India-rubber, and some canvas belts are, namely, woven in plies. The Scandinavia belting belongs to the class of solid-woven cotton belting, and has so round an edge that it stands these tests with small injury, and though it may become worn at the edge through rubbing against a jagged fork, just as a leather belt is worn for the same reason, it does not give way any the sooner. A little greasing at times helps to protect the edges—of course the belts get a little oil upon them from the pulley, and the edge as well as the body of the belt wears shiny-like an old coat. From an old coat one would willingly part with this qualification, but it is not desirable to take the shine out of the belt, as it is this very shine or glaze which protects the fiber and produces intimate contact with the pulley, the adhesion being perfect.

Again, woven belts give and take; this is in the nature of a woven material. When first put on they require "taking up" once or twice more than leather. The stretch is approximatively six per cent., as against four per cent. in leather, but once well to work they give less trouble, as there is only one joint to look after. Also, if there is much wet, they run up or shrink a little. In some mills this tendency is utilized, inasmuch as by simply throwing water over the belt while in motion (hot water is used, I believe) it is tightened, and the requisite adhesion obtained.

If liable to vary between a dry and a wet state the stuff should be shrunk before using, otherwise it might, if not looked after, overstrain the shaft. It may be that a coating of gutta-percha, or India-rubber, would be useful, but it adds immensely to the expense, especially at the present price of gum, and is always liable to injury by contact with various oils, animal and mineral, and other solvents of gum, or by other accident, very little friction sufficing to tear off the rubber in great quantities. As already remarked, a further disadvantage with India-rubber belts, as at present made, is, that they are woven in plies or layers of canvas, upon which the belt relies for its strength, and these are liable to get torn asunder, besides being of relatively less tensile strength than solid-woven belts.

The question of tensile strength is, of course, one of great importance, and I have brought with me, for the inspection of all who wish to see it, the certificate of certain tests made by Mr. David Kirkaldy, of Southwark Street, who is doubtless known to you. These tests show enormous tensile strength. To take an example—a 3½ inch medium Scandinavia cotton strap breaks with an ultimate stress of 4,187 lb., and the best single leather strap to be obtained of similar dimensions falls short of that. In Cooper's book on the uses of belting, which I have here for your inspection, some tests of Mr. Kirkaldy are quoted on page 14, in which the ultimate strength of a B ½-inch leather strap is giver at 3,007 lb. This must be very exceptional, as on page 208 we find from some tests in the chain-cable testing machine at Rotherhithe that a 4-inch stout leather band of good quality broke at 2,100 lb. These figures speak for themselves as to the relative tensile strength of cotton and leather.

Mr. Kirkaldy gives also the strength per square inch of section. This is useful, and, indeed, necessary, with the testing of iron plates, or, perhaps, of belting too, if the thickness is ascertainable exactly; but here it is no guide, as the thickness is an uncertain element in calculating the strength. Thus a 4-inch light belt has a thickness of 0·15 of an inch, and a medium strap, which contains more threads in the ratio of 3 to 5, has, perhaps, the same thickness from being woven lighter or rolled flatter.

Whilst on the subject of tests it may interest you to observe that tarring the belts slightly diminishes their strength, as it does also with ropes.

I have now some prospective advantages to put forward. In what is prospective there is always naturally the element of uncertainty, and I shall hope to hear something on this head from those gentlemen who may favor us with a few remarks later, and they may depend on my deferring to their superior judgment. Firstly, I think that pulleys destined to be turned by the Scandinavia cotton belting might be mounted to take wider straps. Sometimes the mere widening of a guide fork allows of the use of a wider belt, but a slight widening of the pulley rim is no very formidable matter, if I may judge from a price-list I saw this morning. I may remind you that the highest mechanical authorities have lately expressed their belief in the wisdom of using wide light straps in preference to narrow thick ones. This may be partly owing to the fact that in increasing the strength of the leather by adding another layer—in short, by using double belts—the advantage is considered doubtful, as the exterior layer, while in work, is distended, and the interior relaxed. This objection applies with especial force to small pulleys. By increasing the area of belt contact you have much better running.

Now the great objection to the use of wide straps—namely, their expense—is greatly removed, as wide Scandinavia straps are four or five times less costly than leather. This it is which gives them real commercial importance, as if you add to the saving in first cost the saving in belt laces the economy achieved is really remarkable, and the time lost during the first days of use, which is generally made so much of (so much so that one would think a leather belt never required taking up at all), is much more than recovered in the life of the belt. Besides, if the belt is well stretched before putting on the pulley, this initial loss of time is, to a large extent, avoided.

Next, I think that the pulley-rims might be made a little more convex than usual. The average convexity, which is as much as a leather belt will bear without cracking and straining, is about 3-16ths of an inch to the foot in breadth, and this helps to keep the belt in its place on the pulley, and I think helps to prevent slip. This convexity, if thought desirable, might be increased without any injury to a pliable cotton belt, as it fits the pulley like a glove.

One more suggestion for your consideration. A very simple contrivance might be applied to the guide forks which would save much wear and tear at the edges of the belt—namely, a small wooden pulley or reel might be attached at each side of the fork, at a very light cost, in a manner that

would have the effect of preventing the cutting that may perhaps in some cases occur.

Having prepared this paper at very short notice, I have not had time to get reports from Swedish users of the Scandinavian belts, or should have had, no doubt, many applications of special interest to describe, as they have been used there these three years, and doing all classes of work, from main driving downwards, running indoors and out-of-doors, and in water itself. From a weaver of coarse linens I hear that some of the looms which, to use his homely but expressive phrase, were liable to "jigging" and shaking with leather, were completely cured by the use of cotton straps; the same with a wood-planing machine working in the same factory. Here, in England, it has been already used and approved by large paper mills, saw mills, flour mills, and cotton mills. A cotton belt, 39 feet 5 inches long and 5 inches wide, of medium strength, supplied by the well-known firm of G. Spencer & Co., 77 Cannon Street, was put to work at the North London Railway Works at Bow, on 16th July, 1879, to replace a double leather belt costing six times as much. Mark that, gentlemen, please. It was used to drive a circular saw 3 feet 6 inches in diameter to saw 14-inch logs. The cotton belt has been used ever since and gives every satisfaction, and has not given any trouble. Such a success as this has fairly astonished me, as to replace a double leather belt of similar width was almost too much to expect from so light a belt.

With such economy achieved, gentlemen, is it not reasonable to hope that the Scandinavia cotton belts will be welcomed by all large users who favor simplicity, efficiency, and economy, and will personally see that they have a fair trial? They are not a marvel of inventive genius—they have none of the imaginative charm which is attached to many inventions of great theoretical value. They have plain practical value, and, though they come from Scandinavia, will recommend themselves none the less on that account to John Bull, who is equally willing to welcome the great Swedish Arctic explorer who brings us tidings of strange far-off lands, or a homely specimen of the industrial arts of a great nation.

DISCUSSION.

Mr. A. H. BATEMAN wished to know the difference in price of the woven band per foot run as compared with that of leather.

Mr. COBBETT said that the price charged by a well-known manufacturer for 12-inch single leather straps was 6s. 6d.; his price would be 2s. per foot, and the wider the strap the cheaper in proportion to leather.

The PRESIDENT asked how long the invention had been in existence, and if it had been practically tested for any length of time.

Mr. COBBETT replied that the invention was four years old, and had been used in most of the factories in Sweden, more especially in saw mills, in which the work was especially severe as regarded high speed, and it had been found to be not only cheaper but better than leather. He had quite recently received testimonials from the well-known manufacturers Stromman & Larsson and J. A. Kjellberg & Soner (of Gothenburg), who had had the band in use for some years, and who had pronounced it to be superior to any other belting they had used.

Mr. CASSELLS said that he was very much in favor of the band. He wished to know how much narrower it became when it was stretched, and to what thickness it could be made. He was under the impresssion that a thin strap would not bear the strain of driving heavy machinery. He had found that there was considerable difficulty in the making of the "joins" in the straps that he had had anything to do with, and there was only one strap that had overcome that difficulty. That was a strap made of felt which he obtained from Manchester, and it was joined by gutta-percha, but, of course, that would not suit hot places.

Mr. COBBETT, in answer to Mr. Cassells, said that as to the thickness, they prided themselves in this patent upon getting a requisite amount of work with less thickness of cotton than of leather, and they were able to produce it at a lower price. With regard to the join referred to, it was somewhat similar to the one he had described in his paper, substituting gutta percha for marine glue. Experience had proved that as the band wore the edges became polished, and were protected thereby, though he admitted he had expected otherwise. The bands had been working in a guide fork for three years, and had worn well.

Mr. F. H. VARLEY said that through the kindness of Mr. Cobbett, who supplied him with several samples of Scandinavia and leather belting, he had been able to make some experiments to test their comparative pliability. He had for a considerable time regarded the use of leather for the purpose of transmitting motion from shafting to shafting as a very unsatisfactory material from its want of pliability, but he was not prepared to find so great an absorption of power until he had made definitive experiments. These experiments consisted in ascertaining the amount of distributed pressure necessary to bend the several samples of belting to a curvature equal to that of a rigger three feet in circumference, and from these results the following table had been made out:

SCANDINAVIA BELTING.

Width. Inches.	Pressure in ounces. Plain. oz.	Tarred. oz.	Remarks.
1½	½	1	
1¾	*	1	* Tarred sample only in this
2	¾	1	width.
2½	2	3½	Scandinavia Belting being
3	3	6	manufactured in three sub-
3½	3	6	stances—light, medium, and
4½	3	0	heavy — the difference be-
5	0	3	tween the 3-in. tarred and 5-in.
6	0	5	ditto is due to the latter being
8	0	7	made of the lighter fabric.
11	0	9	

LEATHER BELTING.

Width. Inches.	Pressure to bend. lb.	oz.	Remarks.
1	0	8	A well-used and very pliable belt.
2	1	0	Light leather.
3	1	6	
3	1	0	Light leather.
4	6	0	Medium heavy single ply.
4	28	0	Heavy double ply, ½-inch thick.
5	4	0	Light for width of belting.

It would be seen that the comparison between Scandinavia cotton belting and leather in the most favorable instance (so far as leather is concerned) gave the pliability of the former as 16 times that of leather, whilst with heavier leather belts the comparison showed that Scandinavia belting is 32 times as pliable, whilst in one sample, that of the leather belting 4 inches wide made of a double ply, and the total thickness of which is half an inch, we had the astonishing difference of 28 lb. as compared to 3 oz. if we took the corresponding width in cotton belting, or as 28 lb. to 9 oz. when we compared it to Scandinavia belting 11 inches broad. Now what did so great an amount of stiffness in a belting mean? Nothing less than a waste of energy, which could not possibly serve any useful purpose. To illustrate this we might take the case where the weight distributed over 1 foot=1 lb. We next assume the rigger to be 3 feet in circumference; 1 revolution of such rigger will therefore necessitate the expenditure of 3 lb. in bending the belting, and 3 lb. in unbending—total 6 lb. per revolution. Assuming, then, that the rigger made 300 revolutions per minute, we had 300×6, or 1,800 foot-pounds per minute, or 0·05454 of a horse-power. But in the case of the 28 lb. belt the power absorbed= 0·05454×28, or 1·52712 horse-power, in round numbers 1½ horse-power, and this waste of power increased in direct proportion to the increase of speed. Six hundred revolutions per minute would absorb 3·05424 horse-power, and where several belts were running then each belt contributed its relative waste of power in which no useful effect could be derived, but, on the contrary, this very factor of stiffness helped materially to reduce the proper amount of adhesion or grip which a belt should have over the driven riggers. For these reasons alone he was glad to see that it was possible by means of the specially woven cotton belts to obtain more effective driving power, and from the manner in which these belts were doing work at Messrs. Walkers, Parker & Co.'s Lead-Rolling Mills at Lambeth, he believed there was little left to be desired. The belts were certainly not wanting in adhesive or gripping power, and taking the opinion of the foreman, a practical man of some experience, they were working most satisfactorily in all respects. The difference, then, of pliability alone would recommend such belts to more extensive adoption, and in such cases as driving dynamo-electric machines for the production of the electric light they would, he believed, be found admirably adapted, because such machines had to be driven at a high speed, and require considerable power, and he further expected to see a greater development of that class of machinery which he termed high speed power machines—such, for example, as the wood planing and carving and moulding machinery, where the whole breadth of a plank of wood could be perfectly planed or moulded with one traverse under rotary cutters.

Samples of the belting which was employed for these experiments were passed around the room, and the leather belt which required 28 lb. to bend it was much commented upon.

Mr. BATEMAN said he had had considerable experience in running machinery at high speeds, for which the woven band was well adapted. He had always been opposed to thick double belts for that purpose, as also to rubber belts. He had also used Helvetian leather, which was not very lasting; but he had lately tried experiments with Mr. Cobbett's Scandinavia belting, and had been very much pleased with it. He had carefully noticed the edges of the belt, but had never found that they had frayed out or given way. The edge became dirty, but that did not matter. There did not seem to be the same violent friction in the cotton belt as there was in the leather belt, and there was not the same cohesion between the edges of the cotton belt and the striking gear as there was between the leather belt and the striking gear. He was astonished to hear the startling views of Mr. Varley as to the relative pliability of the two bands. When they heard of three ounces against many pounds it was surprising, and he was thinking of selling his engines and buying some of half the size. When Mr. Varley stated that 1 to 1½ horse-power had been expended in bending one strap he thought Mr. Varley was putting it too strong, but they all knew that Mr. Varley would not commit himself to statements of that sort unless he was quite sure, and he (Mr. Bateman) would certainly try the belting to a much larger extent. He had been trying tarred belting, which he thought just supplied the happy medium between too much and too little grip. He hoped that the invention of Mr. Cobbett would not share the fate of several inventions brought before their Society, which were talked about, applauded, and then forgotten. He thought every member of the society should try it, and that could be done for a very small cost, and he wished to bear his testimony to the fact that the band could be made to do any ordinary work.

Mr. VARLEY stated that Mr. Bateman had expressed some surprise at the great discrepancy of 28 lb. and a few ounces between the pliability of leather and the cotton belting, but they would find that the latter would bend from its own weight, and it only required a small amount of pressure in excess to make it fit round the rigger.

Mr. COATES said that the force of a belting did not depend upon the friction, but adhesion, and he believed that in this woven belting there was not sufficient adhesion, and wished to know the quantity of electricity produced, and whether it was inflammable.

Mr. COBBETT replied that the amount of adhesion might be regulated by the way the bands were impregnated. He had been over shops and found sawdust flying in all directions, but there had never been any danger of it igniting.

THE PLATTSMOUTH BRIDGE OVER THE MISSOURI.

THIS structure is now being built across the Missouri River, about a mile below the city of Plattsmouth, Neb. It forms the connecting link between the Iowa and Nebraska divisions of the Chicago, Burlington and Quincy Railroad. The whole length of the work is about 3½ miles, of which more than two miles is in the east approach, one mile is in the west approach, and the permanent bridge is just 3,000 feet long.

The east approach consists of:

First. An embankment 1½ miles long. This is on the Iowa bottom-land, and is from 5 to 25 feet high. It is partly on a level and partly on a rising grade of 1 per cent. toward the bridge.

Second. A temporary wooden trestle, 2,000 feet long, in 100 spans of 20 feet each, also built on a 1 per cent grade.

The west approach consists of:

First. A side-hill embankment, about ½ a mile in length, crossing two small ravines drained by arched culverts.

Second. A cut, ½ a mile long, ranging to 85 feet maximum depth. In the deepest part of the cut, a temporary line, with curves of 250 feet radius, has been adopted. The material lying between this and the permanent slope is to be used in filling the wooden trestle on the east approach.

The permanent bridge consists of 2 through spans of 400 feet each, over the main river; 3 deck spans of 200 feet each over the adjacent sand-bar, and 1,560 feet of iron viaduct, of which 1,440 feet, in 48 spans of 30 feet each, are on the east side.

The 5 main spans rest on 6 piers, numbered in order from the west shore, and briefly described as follows:

Pier one, on the west shore, is founded on the rock 30 feet below low-water mark, excavation being made in an open coffer-dam, through blue clay and bowlders. This coffer-dam was filled with béton and rubble stone, and masonry was begun at 2 feet below low water.

Pier two, in the middle of the river, is founded on the rock 32½ feet below low water, by sinking a pneumatic caisson 21 by 51 feet, through about 15 feet of sand. This caisson was surmounted by a timber crib-work, filled with béton, and masonry was begun at 2 feet below low water.

Pier three, on the east shore, is founded on the rock 52 feet below low water, in a similar way to pier two, the chief difference being the greater depth of sand lying on the bed-rock. Masonry was begun a little over 6 feet below low water.

Piers one, two, and three are of the same general form, and their tops finish at a height of 62 feet above low water. Under the coping courses, they measure 8 by 33 feet, the ends being semicircles of four feet radius. They are built with a batter of ½ an inch per foot on sides and ends. At 34 feet below the coping courses the ends are changed to a pointed form, the lines being arcs of circles struck from points seven feet apart. At the foot of the battered work the piers are 13 by 44 feet. Offset courses increase this size in the bases of piers two and three.

These three piers are of first-class rock-faced masonry, laid in Portland cement, and backed with béton.

Pier four is founded on the rock 54 feet below low water, by sinking the pneumatic caisson, 18 by 40 feet, through 65 feet of sand. The masonry of this pier begins one foot above low water, the intermediate height between it and the caisson being made up of a crib filled with béton.

Pier five rests upon 78 piles, driven inside of a curb, 18 by 40 feet, to an average penetration of 30 feet below low water. These piles are capped with a grillage, and surrounded, inside the curb, with béton, and the masonry is begun at low water.

Piers four and five measure 7 by 27 feet under the copings, have semicircle ends, and are about 30 feet high. They are of first-class rock-faced masonry, with rubble backing, and are laid in Portland cement.

Pier six is founded on concrete 3 feet thick and 12 feet wide, by 33 feet long. The masonry is similar to that of piers four and five, but is only 6 feet thick under the coping.

Piers three, four, five and six, carry the three-deck spans. These are each 200 feet long between centers of end pins, 30 feet high and 16 feet wide between centers of chords. They are Pratt trusses, with single intersection webs and inclined end posts, and have each 8 panels of 25 feet. The floor-beams rest on the top chords, and the track stringers are riveted to the webs of the floor beams. There is a grade of ½ per cent. on these spans, made by placing each span at a different elevation, the second and third being respectively 1 and 2 feet higher than the first span, and the grade in each span being made by varying the depth of the floor-beams on the chords. The third span rests in recesses left at the proper elevation in the masonry of pier three. The 200-foot spans are entirely of iron, except the pins, which are steel.

Piers one, two, and three carry the 2 400-foot spans. These are each 400 feet long between centers of end pins, 50 feet high, and 22 feet between centers of chords. They are pin-connected Pratt or Whipple trusses, with inclined end posts, the web being arranged with double intersections. Each span has 16 panels of 25 feet. The ties are in two lengths, and couple on pins passing through the centers of the posts. Attached to these pins, a strut extends between each pair of posts, and a system of diagonal wind bracing connects these struts with the top lateral struts. The middle of each inclined end-post is supported by a horizontal lattice-work strut, which reaches to the first vertical post. The floor-beams are riveted to the posts immediately above the bottom chords, and act as lateral struts, the lateral ties being coupled on pins, passing through jaw-nuts, screwed on the ends of the lower chord pins. The stringers are riveted to the webs of the floor-beams.

In these trusses, the top and bottom chords, inclined end-posts, main and counter ties, lateral rods, pedestals, rollers, and all chord and lateral pins are of steel. The intermediate posts, end suspenders, lateral struts, portals, stringers, and floor-beams are iron.

The floor system is uniform on the iron viaduct and on the five spans. The track stringers are spaced 9 feet between centers. On these rest 9 by 9 oak ties, spaced 15 inches apart, centers. These are generally 12 feet long, locked by 10 by 10 oak guard rails, placed on the ends of the ties. At 5 foot intervals, ties 16 feet long project, carrying a foot-walk of 2-inch oak plank on each side; and at 25 foot intervals 18 foot ties are inserted, to carry an iron stanchion, through which will pass a wire cable for a handrail. Between the rails are placed two 4 by 5 inch angle irons for inner guard rails, bolted to each tie, and distant 6 inches from each rail.

The contractors on the work have been as follows:

For earthwork on approaches, N. S. Young, of Burlington, Ia.

For construction of wooded trestle, Eaton, Young & Co.

For masonry on approaches, Jenkinson & Drexel, of Omaha, Neb.

For constructing and sinking of caissons for piers two, three, and four, Gen. W. Sooy Smith, of Maywood, Ill.

For béton work of all kinds, J. C. Goodridge, Jr., of New York city.

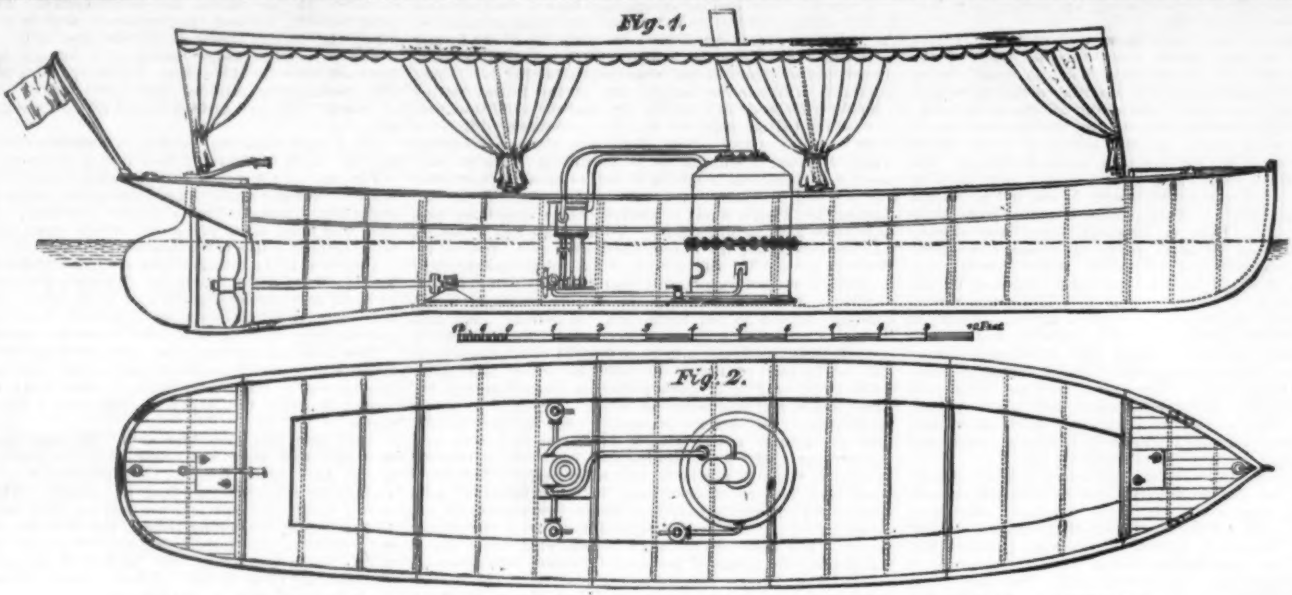
For masonry of piers, W. H. B. Stout, of Lincoln, Neb., succeeded by Reynolds, Saulspaugh & Co., of Rock Island, Ill.

For iron viaduct and 200 foot spans, Kellogg & Maurice, of Athens, Pa.

For manufacture of steel, Hussey, Howe & Co., of Pittsburg, Pa.

For 400 foot spans, Keystone Bridge Co., of Pittsburg, Pa.

The substructure and superstructure have been designed throughout by the Chief Engineer, George S. Morison, and the work has been executed under his direction, assisted by the following staff: H. W. Parkhurst, First Assistant Engineer; C. C. Schneider, Assistant Engineer of Superstructure; B. L. Crosby, Assistant Engineer, and W. G. Dilworth, Assistant Engineer.—*Engineering News.*



STEEL SECTIONAL LAUNCH FOR EXPLORATION IN CENTRAL AFRICA.

TEMPORARY BRIDGES.

A FRENCH engineer, M. Bouilliant, has invented and perfected several models of bridges which require for their construction nothing more than such undressed woods as may be found almost anywhere. They may be put together and taken apart again in a few hours, and appear to be destined to render great service on farms and in gardens and parks, and to prove of great utility in military operations, etc. We give herewith a representation (Fig. 1) of one of the models of these temporary bridges. It will be seen that the girders supporting the platform are sustained by three cross-girders; and that the latter are supported by a truss composed of poles tied together diagonally. The whole truss is firmly braced, as shown in the cut. These bridges may be constructed entirely of wood, if there be wood at band capable of furnishing material for tying; of wood and rope; or of wood and iron wire. Finally, they may be constructed still more solidly by means of a device invented by M. Bouilliant, and called a "put-log fastening." This fastening, which may be also used for many other purposes, such as the construction of scaffolding, etc., is composed of a chain to surround the ends of the pieces to be joined, and a nut (Fig. 2). The nut is provided with an eye, to which is attached one of the end links of the chain, and a hook to which may be attached any other link that may be desired. The nut is traversed by a screw having at the upper extremity a lever, and at the lower a small metal plate. The figure shows well enough how the fastening is used without the necessity of an explanation.

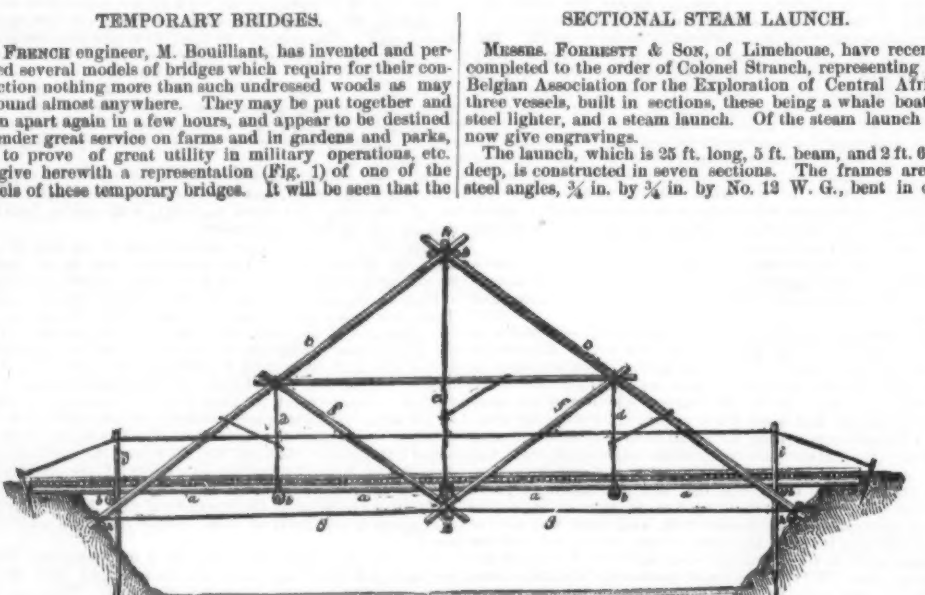


FIG. 1.—MODEL OF TEMPORARY BRIDGE.

a, string-pieces; *b*, cross girders; *c*, two diagonal main supports; *e*, braces; *f*, cross-stays; *g*, ropes uniting the two main supports; *h*, stakes for supporting the end cross-girders.

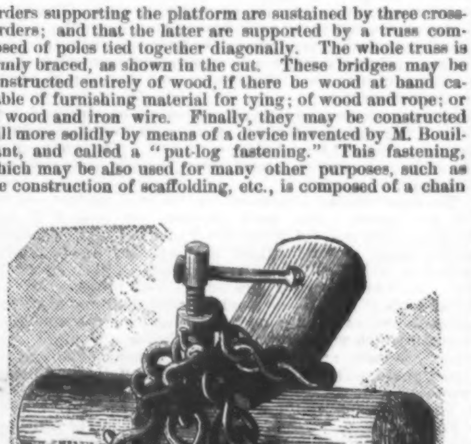


FIG. 2.—BOUILLIANT'S PUT-LOG FASTENER.

SECTIONAL STEAM LAUNCH.

MESSRS. FORRESTT & SON, of Limehouse, have recently completed to the order of Colonel Stranch, representing the Belgian Association for the Exploration of Central Africa, three vessels, built in sections, these being a whale boat, a steel lighter, and a steam launch. Of the steam launch we now give engravings.

The launch, which is 25 ft. long, 5 ft. beam, and 2 ft. 6 in. deep, is constructed in seven sections. The frames are of steel angles, ¾ in. by ¾ in. by No. 12 W. G., bent in one piece from gunwale to gunwale, every third frame being double where the hull is divided. There are three double water-tight bulkheads, one at each end, and one between engine and boiler, the other divisions being formed by double frames without plates. The keel is of bar steel, 1½ in. by ¼ in., stem and post the same. The after post is formed with a double tongue at the bottom, which fits on to after end of keel; the top of the post is fitted to a socket under the counter. The boat has a gunwale bar of steel, 1 in. by ¾ in. by No. 12 W. G., extending all round outside the shell plating; an American elm rubbing piece is securely screwed to this angle. Both the angle and wood are divided at the several joints in the hull.

The hull is plated throughout with No. 24 W. G. steel plates with single riveted laps and double riveted butt straps. Both angles and plates were all galvanized before being worked. The extreme fore and after sections are decked over with teak, having a small water-tight hatch to admit of their being used as lockers. Teak seats are fitted at the sides supported by brackets, and one thwart aft for steersman. An awning is fitted over the hull, supported by a light framework of galvanized iron.

The connection of the various sections is made by nut and screw bolts passing through the double frames; a piece of India-rubber moulded to the shape of the frame is placed between, and the bolts are screwed up with two nuts and a washer.

The engine is a single inverted direct acting, 5 in. by 5 in., being constructed so as to be readily taken to pieces for transport over land. The boiler is of the vertical type, being constructed of steel. The firebox is made separate, the boiler resting upon it. There is a joint in the middle of the boiler, and also at the top: the tubes can also, if necessary, be taken out, so that the boiler can be divided into a number of parts, no one of which shall exceed a load for two bearers to carry between them upon a pole.

This steam launch will accompany an exploring party of about 150 men led by Captain Ramaecken.—*Engineering.*

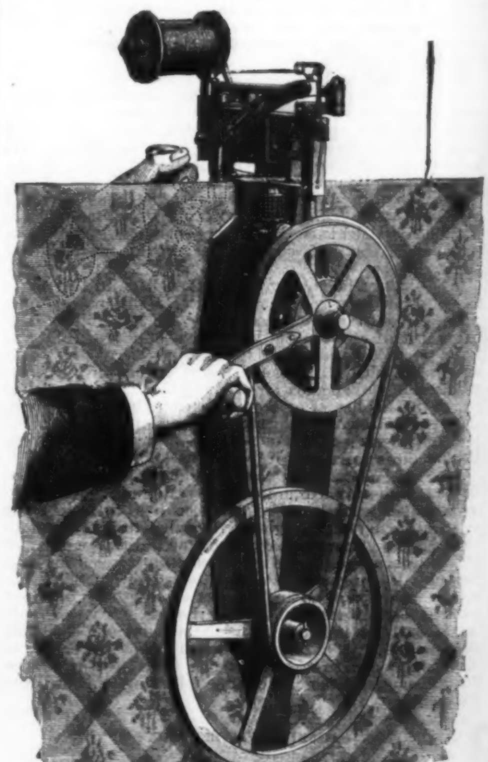
SOLUBILITY OF THE METALS IN PETROLEUM.—The author, referring to the experiments of Dr. Stevenson Macadam, maintains that lead, zinc, tin, copper, magnesium, and sodium are only attacked by petroleum under the joint influence of air or oxygen, when acid compounds are formed, which the author is at present examining. Petroleum washed with caustic alkalies and distilled in carbonic acid has no solvent action on metals. The oxidizing effect of oil of turpentine upon lead does not, according to the author, depend upon the formation of ozone.—*C. Engler.*

CARPET SEWING MACHINE.

THE carpet sewing machine, of which the accompanying is an engraving, is the invention of Mr. Joseph Hesse. The Singer Manufacturing Co. are now manufacturing them at their factory in Elizabeth, N. J. Carpet sewing by machinery has often before been attempted, but previous to this no carpet sewing machine had been made that might be considered successful.

In the new Singer carpet sewing machines the heretofore objectionable features have been overcome, and the work for which they are intended is accomplished by them with great rapidity and in a manner that gives great satisfaction.

The carpet to be sewed by these machines is first suspended in an upright position by hooks which are made fast to the ceiling at intervals of about four feet apart. The edges thus brought together are stretched by the means of pulleys or some equivalent contrivance; the machine is then placed astride of the edges of the suspended carpet, and it is so constructed that it grasps them both tightly together by the means of feed wheels, which also cause the machine to advance toward the operator as the sewing proceeds. A very small amount of power is required to run one of these machines, and the position of the operator is such that it can be readily observed whether or not the pattern is properly matched. Another advantage that is claimed for these machines is, that while sewing, they turn all the nap upwards, so that it is on the underside of the carpet when laid down.



CARPET SEWING MACHINE.

CRYSTALLINE FORM OF MAGNESIUM.—The normal form of these crystals is a regular hexagonal prism terminated by a base rather less brilliant than the lateral faces. Among the rhombohedric metals magnesium next to zinc affords the most acute primitive form. The crystals are very malleable and sectile, and no cleavage was observed.—*M. des Cloizeaux.*

ANTISEPTICITY OF COPPER.—The author considers it as proved that copper is a prophylactic against cholera and typhoid fever.—*Dr. Burq.*

THE SINKING OF RAILWAYS IN BOGS.

ON the 4th of April last, a train on the New York, New Haven and Hartford Railway was wrecked by the sinking of the track in a bog near Meriden, Connecticut. It was found on examination that the track had been laid along the edge of a pond which had become filled with peat. A vast amount of sand and gravel was dumped into the cavity, but the continued settling of the track showed that solid and permanent bottom had not been reached. Shortly after midnight, June 4, the watchman at the spot heard a loud report, and saw about two-thirds the width of the roadway, for a distance of two hundred feet, suddenly sink into the bog, so as to bring the tops of the telegraph poles about to the former level of the track. Not daunted by the first failure to secure a stable roadbed, the railway company has undertaken to fill up the gap again, though some experienced engineers are of opinion that it would be cheaper to carry the road around the bog by a long detour, and so avoid all risk of another submergence. The last cave-in fortunately occurred when no trains were passing. This mishap has recalled several other more or less notable occurrences of the sort.

In 1870, when the Monticello and Port Jervis Railroad was being graded near Gilman's, it was noticed that the ground for several rods was moist and "shaky." It required much filling to make a solid road-bed. A year afterward, the road having been in operation several months, the watchman of that section of the track was walking along the railroad just after the passenger train to Monticello had passed the spot. Suddenly he saw the railroad embankment gradually sinking for a long distance ahead of him. He ran to a high bank at the side of the road just as the railroad dropped, with a loud noise, 15 feet below the surface. It required days of labor and the driving of long piles to construct a secure foundation for the rails.

The New Jersey Midland Railroad was constructed in 1870, through the northern part of New Jersey, and was graded over a marshy place between Snufftown and Port Tuttle. One night the laborers quit work, after several days' labor, having almost completed the work at that point. When they went to their task next morning they were amazed to see that where the road-bed had been was a pond of thick, muddy water, 600 feet long and 25 or 30 wide. The men attempted to sound the depth of the mysterious pond, but an iron rod 40 feet long failed to reach any foundation. The swampy flat where this phenomenon was witnessed was once heavily timbered, but a portion of it had been cleared and used for meadow land. Its surface was such, however, that a team could not be driven over it, and a person in walking across any of the meadows would cause the surface to shake for several feet around. Near by there are "boiling springs," so called from the manner in which the water gushes out of the earth The water of these springs is of excellent quality, and never varies in volume, streams of moderate size being formed. If the stories of people living in the vicinity are true that curious-looking fish without eyes have been taken from these springs, the theory that an underground lake of considerable size exists there would seem to be beyond doubt. All the surroundings indicate that a natural pond or lake once covered the surface.

An examination of the spot was made at the time of the sinking of the railroad grading by several scientific men, and they were of the opinion that the lake had been incrusted by the accumulating vegetable matter of numberless ages until a surface had formed sufficient to sustain forest growth. The boiling springs were regarded as outlets to the subterranean lake. As there was no thoroughfare for the road anywhere else in the vicinity, the gigantic task of making a substantial road-bed in the "Snufftown Sink," as it was called, had to be accomplished or the railroad enterprise abandoned. Bottom was found at a depth of 90 feet. Nearly two months were occupied in overcoming the "swallowing-up" capacity of the sink. It was a week before any effect of the vast daily work of dumping thousands of cart-loads of gravel, hundreds of trees, rocks, etc., into the sink was noticeable. A solid bed was made, however, and no difficulty has ever been experienced from any settling of the track.

The Jefferson branch of the Erie Railway was built in 1872-3. It is a coal-carrying road, and climbs the lofty hills of Northern Pennsylvania from Susquehanna to Carbondale. When it was in course of construction, the road-bed for a distance of a quarter of a mile disappeared one night. An apparently bottomless bog appeared in its place. Into this pit 10,000 cart-loads of gravel, and over 500 huge hemlock trees, branches and all, were thrown, without having any visible effect toward forming a bottom. A pile 40 feet long was then driven down its entire length. Upon it another one of the same length was placed and driven down, and still no bottom was found. Four of these long timbers were forced down, one on the other, before solid foundation was reached, proving that the bog, or lake, or sink, was 160 feet in depth. The existence of this curious formation at this spot was the more remarkable because it was on the summit of a ridge 2,000 feet above tide, and all around it were rocky hills and ledges. George S. Redington was then Superintendent of the Delaware Division of the Erie. He had a line of piles driven as above described along both sides of the spaces desired, on which to construct the road-bed. The piles were driven close together and formed subterranean booms, that prevented the passage of anything thrown into the space. The trees were cut off of three acres of land, and a hill containing four acres of gravel was leveled to obtain material sufficient to make any kind of a foundation for the track. The filling of this great sink was probably one of the greatest tasks ever undertaken in railroad building in this country.

A curious instance of this kind occurred on the Whitehall and Plattsburg Railroad in 1872, near Crown Point. A number of laborers were engaged in repairing the road-bed, gravel being carried to them from a bed some distance away by a gravel train. The train had just unloaded at the spot where the men were working, and when the engineer started to return to the gravel-pit, he noticed something wrong with the rails. Upon examination, with the foreman, he found that the rails had moved several inches. They ran on some distance in order to see if the grade had changed any, when suddenly the track, with train and all, dropped with a crash a distance of 20 feet. The fireman was alone on the engine, the engineer and foreman having alighted to examine the track just before the sink occurred. He was assisted to the surface as the banks on either side began to cave in upon the locomotive, which was buried a half-minute later. The earth on all sides opened in large fissures, 4 to 6 feet wide and 50 feet deep, and the surface of the earth for 300 feet was changed into a series of hummocks and gullies.

ENGLISH RAILWAYS.

PERHAPS there is nothing in which the American and English peoples differ so much as in the manner in which their railroad systems are operated. There may not be any marked difference in the manner in which companies are formed, directors chosen, stocks manipulated, and dividends paid or withheld, but in nearly everything else—in the construction of rolling stock, mode of carrying passengers, passenger fares, transportation of luggage, number of employes attached to a train, their duties, etc., etc., there is a very wide difference. In view of this fact, a description of the manner in which English railroads are operated may not be without interest to the American reader.

To begin with, then, it will be proper to acquaint the reader with the English names for the different persons and things connected with railroads. First of all a railroad is called a railway—the Great Western Railway, the North-eastern Railway, the North British Railway, etc. The reader may smile at the application of the term "great" to an English railway, considering the size of that tight little island; nevertheless many railroads are known as "great." But these names were applied when railways were novelties, and they have since been retained.

The railroad depot is called a railway station, a locomotive is called an engine—not an engine, but an "injun." The driver of a locomotive is not called an engineer, but an "injun driver." The conductor is a "guard"—the passenger conductor being known as the "passenger guard," and the freight conductor as a "goods guard;" freight trains being called "goods trains." The "baggage smasher," who is so well known to and such a desperate favorite with the American traveling public, is called a "railway porter."

Passenger cars are called "carriages," and of these there are three classes—first, second, and third—of which I will give a thorough description further on. There are no smoking cars on English railways, or, if there are, they have been lately introduced, and no baggage cars. The guard has a carriage to himself, which is called a van, and in this van the luggage of the passengers conveyed by the train is carried, the labor of arranging it, and having it ready to put off at stations where passengers get off, devolving upon the guard himself.

A PASSENGER TRAIN.

First let me take up the passenger train, the manner in which it is made up, the different classes of carriages, how the train is manned, and how it is run, showing the nature of the duties of the guard and driver. Attached to every station of importance are three responsible persons, to each of whom a separate department of the labor of operating a railway is intrusted.

The first of these is the station master, who has charge of passenger transportation. The next is the superintendent of the locomotive department, who furnishes the motive power for drawing trains and is charged with the duty of keeping the rolling stock in order. The next is the superintendent of the goods department, who attends to the transportation of freight. These three co-operating with each other, and working harmoniously, are able to carry along the business of the railroad quite smoothly. The superintendent of locomotives is "boss" in his own department, which requires the possession of acquired skill for its intelligent oversight; but the superintendent of the goods department is, to a certain extent, subordinate to the station master.

When a train is to be made up, whether regular or special, the station master informs the superintendent of the locomotive department that he wants so many first-class carriages, so many second, and so many third. The superintendent of the locomotive department then instructs the guard of the "pilot" engine to make up the train accordingly. The pilot engine is manned by an engineer, fireman, and guard, and the province of this particular engine is to make up all trains, both goods and passenger.

The train is made up and placed in a siding ready to be attached to the locomotive. The passenger carriages are not merely coupled together. They are screwed to each other. These carriages have no platforms like American railroad cars, for they do not open at the ends, but at the sides. They have spring "bunters." They are attached together by three chain couplings, two near the sides and one in the center. The center coupling is furnished with screws, which enter the ends of the carriages.

After being coupled together the carriages are tightly screwed to each other, the spring "bunters" giving a little to the force of the screws. Thus the train is all of one piece, as it were, and there is no shock when a sudden stop is made. The guard and fireman of the pilot engine perform the work of screwing the carriages to each other. The side couplings are provided to prevent the breaking up of the train in the event of the center coupling breaking.

A FIRST-CLASS CARRIAGE.

A first-class carriage is rather a nobby affair. Exteriorly, it bears all the burnish of a hack, and, indeed, taking away the pole, foot-board, and driver's seat, is very much like a hack in appearance. Each carriage contains two compartments, and each compartment holds from four to six persons, who, in traveling, sit and face each other, two or three on a side. It is a nice way to ride if your opposite companion is a young and pretty lady. These carriages are handsomely upholstered and the seats are quite luxurious.

There is no way of heating these vehicles, but in winter an effort is made to contribute to the comfort of the passengers by supplying tin vessels containing hot water on which to rest the feet. These are renewed at stopping places as the train proceeds on its journey. Smoking is not prohibited in these carriages if the smoker obtains the consent of his fellow-passengers in his indulging in a cigar. Otherwise it is.

When passengers get into these carriages they are locked in by the guard, who carries the key, and they can't get out until he unlocks the door. He does this at every stopping place, unlocking all the doors on one side the moment the train stops and locking them again previous to starting. The passengers can communicate with the engineer or guard by means of a bell rope, which passes through, or on the outer side of the carriages, but this only strikes a gong, and in seventy-five cases out of a hundred it does not work, or the stroke upon the gong is drowned by the noise of the train, and fails to attract the attention of either guard or engine driver. The guard, owing to long practice in operating the arrangement, can sometimes attract the attention of the engineer by it, but it is seldom that the ordinary passenger can.

This method of traveling, although it affords seclusion to the class who wish to travel apart from the "common herd," is open to many objections, some of which may be better imagined than described. It furnished opportunity to Muller to murder a rich banker, whose name I forget, and tempted Col. Baker, the friend of the Prince of Wales, to acts which consigned him to prison and drove him into exile.

A very good story is told about one of the Marquises of Waterford, who was in the habit of traveling third-class for the purpose of studying human nature as it exhibited itself in a third-class carriage. The directors of the company over whose line he traveled principally, learning of his habit of riding third-class, attributed it to parsimony, and instructed their servants to subject the noble passenger to every annoyance by surrounding him with the roughest characters. In time the Marquis began to observe that his surroundings were not the result of accident, but of design, and he kept on watch for an opportunity to retaliate.

One day the guard ushered three chimney sweeps, who were sooty from sole to crown, into the compartment of the third-class carriage occupied by the noble Marquis, placing one on each side and one in front of him. After the guard withdrew, the Marquis asked his sooty neighbors if they would like to ride first-class. Would a duck swim? Of course they would. They had never dreamed of enjoying such a luxury. Thereupon the Marquis left his seat, and, going to the ticket office, purchased three first-class tickets, and personally ushered the three sweeps into a first-class carriage, one of the seats of which happened to be occupied by the Chairman of the Board of Directors, and quietly returned to his own seat in the third-class carriage. The chairman was not only subject to the annoyance of having chimney sweeps for his traveling companions, but experienced the disgust of seeing the luxurious furnishings of the vehicle irretrievably ruined by the sooty contact of the apparel of the delighted chimney sweeps. The Marquis was subjected to no more annoyance after that.

SECOND AND THIRD CLASS CARRIAGES.

The carriages of the second and third class are about the same size of and similar in appearance to an American street car. The seats are placed across the car and there are no aisles, there being a door on each side to every pair of seats, which furnishes ingress and egress. The seats of the second-class carriages are cushioned with leather. In the third-class carriages there are no cushions whatever, the passengers having to be contented with the bare wood.

Some of the second-class carriages are not unattractive in appearance exteriorly, but, as a rule, the third-class carriages are of a dingy yellow and no more attractive outside than they are within.

The rates of fare vary with the speed of the train. It costs more to travel by the express than by the mail, and more by the mail than by the way train—that is, the train that stops at every station on the road. The express and mail trains make very good time. By this train a journey of seventy miles occupies about an hour and forty-five minutes, including stoppages for water. By the mail the same distance is traveled in about two hours and a half. The way train occupies about four hours in accomplishing this distance.

THE GUARD OF THE PASSENGER TRAIN.

The conductor of an American passenger train is an autocrat compared with his English brother, the guard. Still the latter is a very respectable man, and is considered as holding quite a good position. He dresses in a dark uniform, which is a kind of cross between that of a policeman and a naval officer. He wears a cap with a peak, and around the latter is a band of brass, which gives the cap quite a dressy appearance. On the front of the cap above the peak are the initials of the company in whose service he is employed—"G. W. R." or "N. E. R.," etc. Only one R. is used to designate railroad, the term used being, as I have already indicated, railway.

Over his left shoulder and under his right arm passes a band of patent leather, to which is attached a patent leather pouch, in which he carries his chronometer. The portion of the pouch which rests on his side is open, therefore, when he wishes to consult the chronometer, he merely turns the pouch up and the face of the time-piece is revealed. Attached to the same belt, upon his breast, is a silver whistle dangling from a short chain composed of the same metal. With this whistle he starts the train.

The guard is the baggagemaster and brakeman of the train. When the train starts he arranges the baggage, so that that which will be first called for will be ready at hand for the railway porter. He has nothing else to do at this time, for he cannot pass through the train to take up tickets. He cannot communicate with the passengers at all; but that is no matter—they are all locked in and cannot get out.

The tickets are taken up when the passengers disembark, or, on an express train, at the last stopping place. Each passenger must purchase a ticket before boarding a train. This rule is imperative. A failure to comply with it will subject the passenger to a risk of being arrested for intent to defraud the railway company. When a passenger leaves the train he must look after his own luggage.

The check system is unknown on English railways. The guard will not put off a passenger's luggage, although he will have it ready to be called for. It is necessary for a person traveling on an English railway to have his trunk or valise plainly marked with his name and destination. There are persons, however, for whom the guard will put himself to a great deal of trouble, and these are those who understand him and who can afford to pay for his attention to their convenience and comfort.

The guard receives only a meager salary—not more than about seven dollars a week—seldom more than five and a quarter, which represents the amount of the English guinea. A guinea a week is thought to be fair pay. He is willing, however, to add to this salary by giving his attention to passengers. A shilling goes a great way in securing the good offices of the guard. He will hand you politely into and out of your carriage for that amount, and instruct a porter to look after your baggage besides, and the porter will look after it with alacrity after you have also feed him with a similar amount.

If you are traveling first-class you may secure a seat with excellent company by coming to an understanding with the guard previous to setting out. Similarly a lady and gentleman who wish to travel alone may secure a compartment to themselves. Scenes like the following are not uncommon on the platform of a railway station:

Gentleman, with half a sovereign between his finger and thumb: "Aw-Guawd, this aw lady is not very well, and we wish to have a private compartment."

Guard, touching his hat: "Very well, sir, come this way, sir."

Leads the way to a first-class carriage, ushers the pair in, and locks the door. During this proceeding the half-

sovereign has been transferred from the possession of the gentleman to that of the guard.

Gentlemen who desire seclusion in order to discuss private business are similarly accommodated. Even when every seat in the train is filled such favors can be accorded by putting in, beside the parties desiring privacy, persons who are going only a short distance. Strange scenes are sometimes enacted in these secluded first-class carriages. It not unfrequently happens that an escaped lunatic is the fellow-passenger of a timid lady or gentleman. Criminals avail themselves of the privacy they afford to conceal themselves from observation when effecting escape.

PRESTO, CHANGE!

There is, a story told of a lady and gentleman traveling together who were strangers to each other. Suddenly the gentleman said:

"Madam, I will trouble you to look out of the window for a few minutes; I am going to make some changes in my wearing apparel."

"Certainly, sir," she replies with great politeness, rising and turning her back upon him. In a short time he said:

"Now, madam, my change is completed and you may resume your seat."

When the lady turned she beheld her male companion transformed into a dashing lady with a heavy veil over her face.

"Now, sir, or madam, whichever you like," said the lady, "I must trouble you to look out of the window, for I also have some changes to make in my apparel."

"Certainly, madam," and the gentleman in lady's attire immediately complied.

"Now, sir, you may resume your seat."

To his great surprise, on resuming his seat, the gentleman in female attire found his lady companion transformed into a man. He laughed and said:

"It appears that we are both anxious to avoid recognition. What have *you done?* *I* have robbed a bank."

"And I," said the whilom lady, as he dexterously fettered his companion's wrist with a pair of handcuffs—"I am Detective J——, of Scotland Yard, and, in female apparel, have shadowed you for two days—now," drawing a revolver, "keep still!"

In traveling the guard is supposed to look out of his windows occasionally on both sides of his van along the line of carriages for any signal that may be given by the passengers that all is not well. On such a signal being given he communicates with the engine driver by turning a wheel and striking the gong on the engine. If the apparatus does not work he ascends to a lofty perch on the van from whence he can see the engine driver and fireman, and waits for them to look in his direction. If they keep persistently looking ahead he applies his brakes, which slightly diminishes the speed of the train, and this is sure to attract the engine driver's attention when the train is stopped.

Half an hour, however, may have elapsed from the time of first observing the passenger's signal until this is accomplished. The young lady who was assailed by Col. Baker actually clambered through the carriage window, and clung to the side of the vehicle a long time, and was not perceived by the guard until he was signaled by other passengers who observed her perilous situation.

It is no fault of the guard, however, that strange things happen on English railway trains. He has his baggage to arrange, time table to make up, and other matters to look after, and cannot have his head out of the window all the time. Why the English people continue to adhere to such a system of traveling, especially when they are acquainted with the superior method in vogue in this country, it is impossible to conceive.

THE ENGINE DRIVER.

The position of the engine driver is superior to that of the guard. He is a skilled laborer, while the other is not. His pay is more than twice as much as that of the guard, but he has to serve a long apprenticeship before he reaches the position. He begins as a boy in the locomotive shops, cleaning engines, and thus becomes acquainted with all the parts of the machinery. In time he becomes fireman of a goods or passenger engine, a position which involves hard labor and long hours. Then he becomes driver of a goods engine, and, if he exhibits dash and fearlessness, is transferred to the passenger department, being employed first on the way train, then on the mail, and, last of all, on the express.

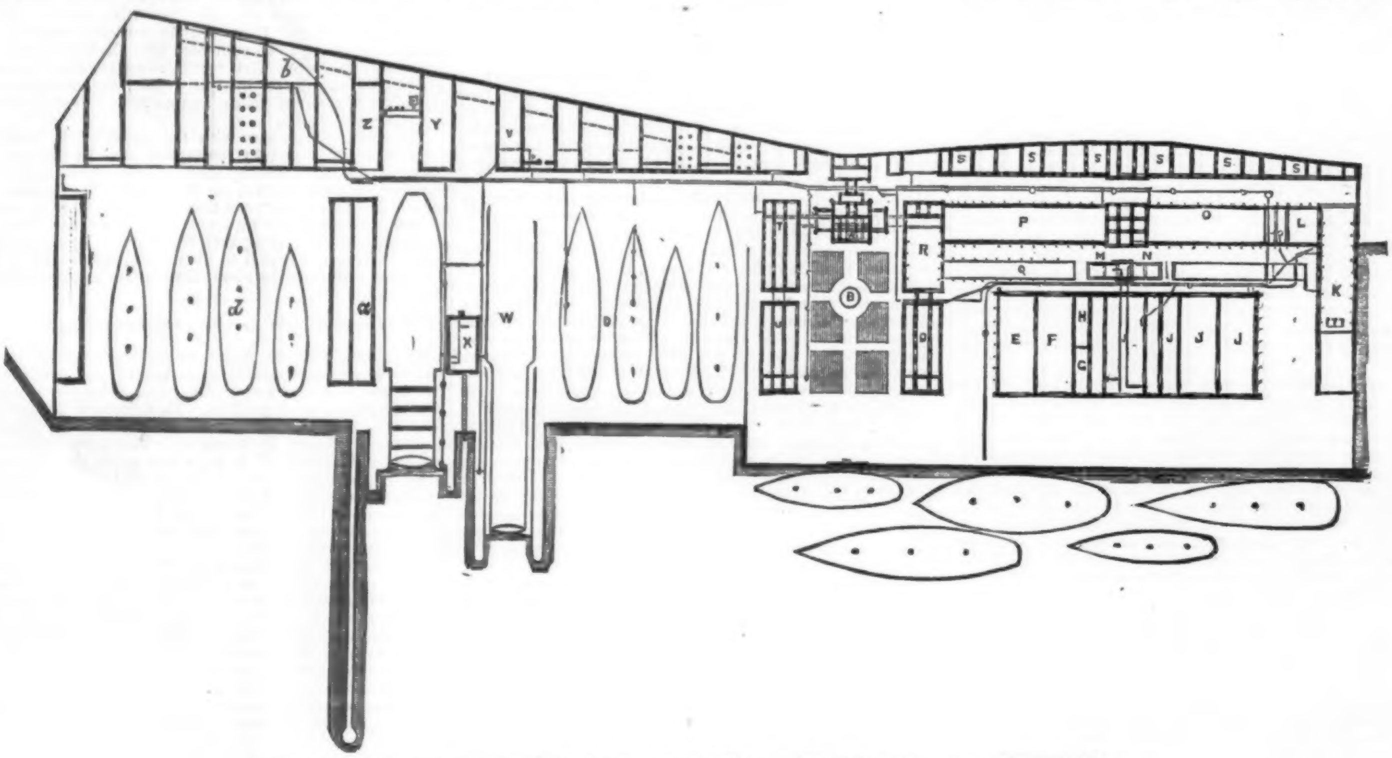
The engine drivers, although not uniformed, dress nearly all alike when on duty—black corduroy pants and vest, blue pilot reefing jacket, and a glazed cap. The driver has nothing to do with the cleaning of his engine, firing up, or, indeed, with any of the details of preparation for the journey. He enters the engine driver's room and finds his assignment on a slate, "John Smith—the midnight express to Newcastle-on-Tyne."

He always runs the same locomotive. He knows its capabilities—knows how much firing it requires, its speed and power. To him it is hardly an inanimate thing; it obeys him so decidedly, and, in his imagination, seems to recognize the touch of his hand upon the lever that opens the throttle valve. When he comes on duty he finds his engine all ready for him, brightly burnished, and the steam hissing from the escape valve—all this the work of his fireman.

He ascends to his place much with the same air that a commander of a ship wears on ascending the side of his vessel to give the order to up anchor. Letting the steam into the cylinders, he slowly moves off to where the train is standing, already made up. The fireman couples engine and train together and screws them into a tight contact. The train is backed down into the station and a quarter of an hour later the porter rings the bell, the guard blows his whistle, and the engineer begins his term of watchful duty. The locomotive has no caboose to furnish shelter from the rain, snow, or cold. It has simply a weather board with a circular eye of glass on each side. To one of these the engineer glues his face, and through the other the fireman peers. Occasionally the engine driver will say:

"Fire, Tom."

And the fireman obediently feeds the puffing monster with its diet of coke. There are no bells on these locomotives and no cow-catchers.—*Commercial Bulletin.*



PLAN OF THE AUSTRIAN LLOYD'S ARSENAL AT TRIESTE.

A, offices; B, quadrangle; C, joiners' shop; D, building slip; E, hammer shop; F, shipsmiths' shop; G, copper shop; H, whitesmiths' shop; J, boiler makers' shop; K, iron foundry; L, brass foundry; M, engine house; N, engine house; O, smiths' shop; P, tool shop; Q, block makers' shop; R, erecting shop; S, stores; T, shed for general purposes; U, boat builders' shop; V, engine and boiler house for patent slip; W, patent slip; X, pumping house; Y, angle iron furnace and frame bending slab; Z, riggers' shop; *a*, ship carpenters' shop; *b*, joiners; *d*, building slips.

THE AUSTRIAN LLOYD'S ARSENAL AT TRIESTE.

AMONG the great steamship-owning corporations of Europe, the Austrian Lloyd's Company holds a foremost place. Possessing at the present time 75 steamers, of nearly 100,000 aggregate tonnage, and nearly 17,000 nominal horse power, this company presents a striking example of the results which may be produced by the combination of large capital, judicious enterprise, and the enlistment of the best technical skill. The company commenced operations in the year 1836, by the purchase of seven small vessels, of a collective tonnage something below 2,000, and since that time its career has been one of uninterrupted success. Thus we find that in the year 1838 it possessed 10 vessels, which remained the establishment until 1842, when one vessel was added. In 1853 the number of vessels had increased to 47, and in the year 1854, the large number of 13 vessels was added, increasing the size of the fleet to 60. The trade in which the present large fleet is engaged is composed of nine general routes—viz., to the Levant, to India, to the Red Sea, to the Danube and Black Sea Ports, to the Archipelago, to Venice, to the coast of Istria on the Adriatic, and to the coast of Dalmatia and Albania. In this traffic the vessels made, in the year 1878, 1,424,031 voyages, carrying, in addition to cargo, 607,100 passengers, and nearly 15½ millions sterling of specie. By a recent decision of the directors, a new line is to be commenced between Trieste and Saigon, Penang, and Hong Kong.

Until the year 1852 the company purchased its ships from private builders, chiefly ordering from English and Scotch firms, the most prominent of which was that of Mr. Peter Denny, of Dumbarton, now occupying so important a place under the leadership of Mr. William Denny. Among the finest ships in the present fleet are some of those constructed by the above firm, and the type of engine now usually adopted and manufactured in the company's arsenal possesses many of the best features of the engines built by Messrs. Denny. In 1852 the company decided to commence the building of vessels for its own use, not only because such a course would prove of great economy, but also because the policy of encouraging native industry and skill was considered, and rightly so, to be the patriotic duty of a great corporation enlarging its operations in a country which, like Austria, had a comparatively limited shipowning and shipbuilding interest.

The administrative offices of the company are in the center of the town of Trieste, and a small arsenal, intended for the repairs of ships, was originally located at no great distance from the central offices, but the accommodation being found too limited, it was decided to establish a larger arsenal, which should be more favorably situated, and at the same time afford an opportunity for laying out comprehensively the plan of a new dockyard, with all the appliances not only for building ships and their machinery, but for docking them, repairing hulls and machinery, and fitting all masts, sails, and equipments—in fact, for producing, if necessary, from the raw materials, a complete sea-going vessel. Many of our readers will know that the town of Trieste lies in a vale surrounded by hills inland, and facing seawards toward a large bay in the northeast corner of the Adriatic Sea. A little to the south of the location of the town itself is a smaller or minor bay called Muggia. This is about eight miles long and five miles broad, and here upon the shore of a bay within a bay, is found a most appropriate natural site, sheltered from storms, and with an excellent foundation for a large ship-building and dockyard establishment.

Entering the arsenal by the main doorway the visitor finds himself in a large square building, constructed, like all the other buildings in the establishment, of massive stone. Here are the offices of the director and administrators of the arsenal, with drawing offices and offices for the principal foremen. This building is marked A in the plan shown herewith. Passing out through the quadrangle (B) toward the quay at which are lying the vessels in process of fitting out one sees, laid out and marked with a regularity of system that strikes the technical observer in every part of the dockyard, the spare propellers and other large gear for the various vessels of the fleet. Near the center of the quay are a pair of sheer legs constructed in 1851 by Seaward, and capable of lifting a weight of 60 tons, the height of the blocks being about 90 feet above the water level. Turning to the left is the joiners' shop, C, of two stories, containing a very complete plant of the usual wood-working tools, chiefly by Western & Co. The machinery in this shop is driven by a horizontal engine taking its steam from a water tube boiler of Roots' patent, and it may be here remarked that throughout this establishment the principle of separating each block of buildings, with machinery driven independently and with separate boilers, has been adopted. Passing over to the hammer shop, E, we find three furnaces—one for use with gas—and two steam hammers, the large one being manipulated with the aid of a powerful steam crane. The whole of the crank shafts, stern posts, and other heavy forgings used in the arsenal are made here, and the unusually heavy shafts, 20 inches in diameter, of the ironclad Tegetthoff were also successfully forged in this shop. Next to the hammer shop is that of the shipsmiths, F, containing seven fires, besides the boilers for driving the forge hammers. Here also is a very fine horizontal engine for driving a line of shafting running along the whole upper end of the smiths' and boiler-makers' shops, J J J J, and from which the smiths' fans and other tools in these shops are driven. Immediately adjoining the shipsmiths' shop are the copper and whitesmiths' shops, G and H. The four buildings to the right of these, J J J J, are the boiler shops, and contain besides nineteen fires a direct action steam-riveting machine, several rivet-making machines, a plate-planing machine capable of planing edges 21 feet long, either square or at an obtuse angle to the surface of the plate, and a pair of well arranged plate furnaces.

The shell joints are riveted by a hydraulic riveter of Shanks' make, the accumulators being driven from the main line of wall shafting. The shell joints are all made with double butt straps, lap joints being seldom or never used. The iron worked into the boilers, and indeed used throughout the establishment, is of Styrian make, and its ductility is shown very graphically by specimens on view in the director's office. The twisting of these specimens exhibits ductility quite equal to that of the best mild steel in use in this country, and it is interesting to mention that the flanging power of this material is so good that in one end shell plate ¾ inch thick, which we observed, the flange had been bent round to right angles in the ordinary course of work with an inside radius of ½ inch. Passing through the iron and brass foundries, K L, one sees an excellent arrangement, the core ovens being at the lower end and the three cupolas near the center. No difficulty is experienced in producing the large and intricate castings into which surface condensers, having the pumps cast underneath—the usual practice here—evolve themselves. In the engine-houses, M and N, are separate pairs of vertical beam engines used for driving the machinery in buildings, O and P. Each of these is of sufficient power to drive the whole of the tools, the one not in use being either under repair or kept in reserve. Next to the engine-houses is the mast and block-makers' shop, Q, the larger portion of the tackle used in the service being made here.

Next in order comes the shop for engine smiths, O, containing a steam hammer, fourteen fires, and a very complete set of screwing machines of English, American, and German make. On the floor above the smiths' shop are the pattern-makers' shop and pattern stores. Passing out of the smiths' shop, and leaving on the left hand two small rooms used one for grinding paint by machinery, and the other for making and repairing injectors and similar light work, we reach the heavy tool shop, P. Here there are some very excellent modern tools, amongst them being a gap lathe, by Whitworth, of 2 foot 6 inch centers and 8 feet greatest radius upon the face plate; a powerful slotting machine of 2 feet stroke, by the same maker; a return-action planing machine, with a face plate 13 feet 6 inches by 5 feet 6 inches, also by Whitworth; a very fine planing machine for planing cylinder faces and other large surfaces, the motion being in the tool itself, which has an extreme stroke of 12 feet horizontally, and a vertical range for feed motion of 6 feet. A powerful lathe of 46 inch centers, by Shanks, has been fitted with a well-contrived arrangement for turning crank pins, the driving motion of the tool round the pin being effected by an extension of the back gear of the lathe. The advantage of this arrangement over machines made exclusively for turning crank pins is obvious, as the main portion of the lathe can be used for general purposes. Above the heavy tool shop is the light tool and fitting shop, and this is without doubt the finest room in the arsenal. It contains an extremely well-arranged plant of screw-cutting lathes, drilling and shaping machines, chiefly by Whitworth, besides vice benches for 100 fitters. In almost every room in the arsenal there have been recently fitted emery grinding machines, by Thompson, Sterne & Co., and the old-fashioned grindstone did not once meet our view.

In the erecting shop, R, there is a large cylinder boring machine, of a very convenient design. Under the center of a stone archway, formed by a gap in the wall, is placed a face plate 11 feet square, and from the center of this, and supported by a girder attached by flanges to each side of the archway, is led a vertical shaft carrying a cylindrical tool-holder, the feed motion being accomplished in the usual way, namely, by a small screw shaft let into a recess in the vertical shaft; the driving is from below, and is effected by bevel gearing connecting the lower socket of the boring pillar with a horizontal shaft running under and beyond the face plate, and with belt drums on its outer end. There are at present in course of erection here several pairs of engines of moderate size, among them being the engines of the Leda, having cylinders 31 in. and 56 in. diameter by 3 ft. stroke. In these engines the air and circulating pumps are cast below the condenser, and are driven from an eccentric placed between two cranks. The cylinders are supported on the side opposite to the condenser by wrought iron columns. Among the features of interest which the design of these engines possess may be mentioned a very novel arrangement of jacketing the cylinders, invented by the director. In a space inclosed at the base of the funnel, and just below the superheaters, is placed a nest of tubes, intended for heating the air contained in them to a high temperature. This air afterwards passes into a box, to which the ends of the tubes are attached, and thence into an annular passage, formed by surrounding the steam pipe with an outer pipe. From this passage the hot air is led through the cylinder jackets, and thence back again into the chimney, the continued circulation being effected by the action of the chimney draught. A registered temperature of 370° Fah. has, by this system, been kept, surrounding the steam pipe and cylinders, and this without the loss incidental to jacketing by steam. Another feature of interest in these engines is an arrangement for varying the expansion in the low pressure cylinder, without the complication incidental to a separate expansion valve. The links are controlled in the usual manner by a weigh shaft with levers at either end, to which the connecting rods to the links are attached, but at the end of the lever opposite the link motion of the low pressure cylinder is a block and hand wheel, arranged that the length of the link rod may be so varied as to change the position of the low pressure link in relation to that of the high pressure engine, and thus effect any desired degree of expansion without changing the position of the high pressure link. To the high pressure cylinder a separate expansion valve is fitted, and the combined arrangement provides a ready means of equally distributing the work between the cylinders when, as is frequently the case with this company's steamers, it is desired to drive them economically at slow speed. Connected to the weigh shaft are a series of rods and bell cranks leading to the bridge, where is fixed an indicator showing to the captain the actual position of the starting gear. This is a most useful automatic substitute for the reply telegraph, and has been in use on the company's vessels for many years.

The most important vessels of the fleet are now fitted with modern compound engines, those in the later ships having been constructed in the arsenal, and the others being chiefly engines of the former simple type, compounded in the usual way by the addition of high pressure cylinders supported upon the low pressure cylinders.

On the sides of the roadway formed between the engineers' shops and the stores, S, is to be seen a further systematically arranged stock of spare gear for the fleet; and in the stores themselves is one of the largest stocks to be seen outside of the Royal dockyards of upholsterer's, rigger's, engineer's, and steward's stores, all controlled from an office centrally situated in the stores themselves. Passing now under the entrance gate, and leaving on the right hand the well provided doctor's shop and dispensary, the visitor reaches the building marked T, which, being close to the shipbuilding slips, has the ground floor devoted to general purposes, and contains a pair of plate rolls 14 ft. 6 in. long, a plate edge planing machine, with a stroke of 13 ft., besides lighter tools. Above is the locksmiths' and opticians' shop, in which are made all the lamps, binnacles, locks, and tinwork required by the company's ships. In the building marked U, there are on the ground floor the boatbuilders' shop and the office of the arsenal harbor master. Above is the sailmakers' loft. The shipbuilding slip marked D has room for four vessels, the length available from waterside inland being about 400 ft. The range of buildings opposite the shipbuilding slip contains fire engine house and guards' residences, where are stationed the sergeant and gendarmes who perform the police duty of the arsenal, painters', flagmakers', gilders', and upholsterers' shops, smiths' fires, and the usual shipbuilding plant of punching, shearing, and drilling machines. At V is the engine and boiler house for working the patent slip. The patent slip, W, is of an extreme length of 750 ft., and is so arranged that one vessel being hauled on the cradle to the upper end of the slipway, the lower end, which has at the sill a draught of about 20 ft., may, by closing the entrance with a pontoon and pumping out the lower part of the slipway inclosure, be so used as to form a separate dry dock for the use of a second vessel. Next to the patent slip is a dry dock intended for the larger sized vessels, and it has an extreme length of 440 ft. and a width of entrance of 75 ft. Situated between the docks at X is the pumping house, arranged to empty both docks; there are a pair of horizontal engines with cylinders 24 in. diameter by 4 ft. stroke, driving, by extensions of the piston rods in the rear of the cylinders, two double action pumps, each with a delivery pipe 3 ft. diameter. These pumps are capable of emptying the larger dock in three and a half hours.

Opposite the dry dock are the angle iron furnace and frame bending slab, Y Y. At Z is the riggers' shop, and above a very commodious mould loft. At *a* is a ship carpenters' shop extending along the quay of the dry dock, and with benches for about forty men. At *b* is, on the ground floor, a carpenters' shop devoted chiefly to the making of landing brows, cattle sling cages, and similar work; and on the floor above is a boatbuilders' shop; in the adjoining building are powerful saw mills, and on the floor above a carpet and oilcloth store. Upon the building slips, *d*, which as yet require extension and piling to be suited for heavy vessels, are at present building two small wooden vessels. There is a very complete fire service laid down throughout the yard, and this is indicated in the plan. The number of men employed in the Arsenal is slightly above 2,000, and the unusual but excellent rule exists that a workman who is absent without leave from his post on Monday must remain away during the week. It has been found that the loss and inconvenience so well known in England from the worship of St. Monday has practically disappeared from the Trieste Arsenal owing to the operation of this rule.

An extremely wealthy pension fund society exists for the benefit of the salaried *employés* in all branches. These number collectively about 1,000 men, and the capital of the pension fund at present amounts to £260,725, some of the officers being entitled to pensions on retirement of as much as £200 per annum. The affairs of the pension fund are managed by representatives chosen by the *employés* themselves.

The present position of the arsenal is largely due to the enlightened energy of the technical director, Cavaliere Petke.—*The Engineer.*

THE PRUSSIAN PATENT OFFICE.

ONE of the most curious cases of a refusal to grant a patent is that by which the Siemens regenerative system has become common property in Prussia. Mr. Jeans, in his new work on steel, relates that the Patent Office of Prussia founded its action on the alleged resemblance of Siemens' important innovation in metallurgical furnaces to one particular mediæval warming apparatus. This apparatus, the only one of its kind, was found at the palace abbey, or preceptory at Marienburg, in Prussia, which formed the headquarters of the Teutonic knights, and is supposed to belong to the latter half of the fourteenth century. It was used for warming rooms in the building in question. A fire was made in the lower part of the furnace, and the products of combustion, passing through the stones placed in the upper division, escaped into the flue. When the stones had been thoroughly heated the fire was extinguished, and the flue closed by a damper. The apertures in the floors of the apartments to be warmed being now opened, cold air was allowed to pass through the heated stones, and becoming warmed in its passage, entered the floor of the rooms through the registers. Some of the furnaces were tried a few years since, and when they had not been meddled with on the pretense of "restoration," were found to be perfectly effective. This contrivance, the Prussian Patent Office decided, was an anticipation of the Siemens system.

A PATENT AGE.

THE question of patents in the United States is one of greater magnitude than most persons would suppose even after giving it considerable thought. We are a nation of patentees as well as of stump orators and tobacco chewers and smokers. We live, move, breathe, labor, and amuse ourselves in, upon, through, and by means of patents of every conceivable kind and purpose. The Lafayette *Leader* has been looking into the subject pretty thoroughly and finds that "we are getting to be a patent-ridden people. There is a patent on almost everything we eat, drink, and wear. In childhood we are rocked in a patent cradle, taught to walk by the use of patent perambulators, dosed with patent medicine, fed on patent food, and amused with patent playthings. Everything we touch during youth from a school slate to a lunch basket, is patented. If we fish, we ride in a patent boat propelled by a patent oar. We throw out our patent bait, attached to a patent hook, and draw in our fish by means of a patent reel, which forms a part of a patent rod. We explode patent cartridges in patent rifles when we go out to shoot birds. We catch wild animals by means of patent traps and snares. We sit in patent chairs, lie on patent beds, and take from a patent table food cooked in patent utensils on a patent stove, the flame in which was started with a patent fire-kindler, lighted by a patent match. Our clothes are cut, sewed, washed, wrung, and ironed by means of patent implements. The machinist spends his time making patent articles with patent machines. The mechanic handles patent tools, and is cautious about making anything new, lest he infringes on some one's patent-right.

"Farmers pay more tribute to patent-right sharks than any class in the community do. They plow, sow, reap, mow, rake, bind, cultivate, thrash, winnow, dig, pitch, and stack by the use of patent machines and implements. If they use some old appliance which was employed by their grandfathers, they are likely to find out that it was patented a few months ago. If they nail a few boards together so as to form a fence panel that will serve the purpose of a gate; if they drive a piece of tube in the ground with a view of drawing water through it, or attach a metal rod to a building to conduct electricity to the earth, they are quite certain to be threatened with an action for damages unless they settle with the agent of the owner of some patent right.

"We all ride in patent carriages, cars, and boats. Most of the street cars are conspicuously marked: 'Manufactured under seventy-six patents.' At death we are placed in a patent casket, covered with a patent shroud, and consigned to a grave marked with a patent stone or other monument. There we rest hopeful of another state of existence in which patent right men 'cease from troubling.'"—*Modern Argo.*

NEW SOUNDING LEAD.

THIS new apparatus is designed for ascertaining the depth of water in which a vessel is sailing, and is the invention of M. Lecoentre. To use it, a line is attached to the ring at the top, and the lead is dropped perpendicularly into the water, care being taken to throw over plenty of the line in coils so that the descent of the apparatus may not be impeded. As the lead descends, the helix at the apex is caused to rotate by the water which it traverses. On the axis of

the helix is mounted a bevel-wheel, which transmits motion to a system of gearing, and the latter moves the hands of two dials—one of them making meters, and the other tenths of meters. In this manner, after the apparatus has been properly regulated, the exact depth of the water may be ascertained. The helix is so arranged that it moves the hands only during the descent of the lead, becoming loose on its axis as it is hauled up. The apparatus may be used not only on vessels which are lying-to, but on those which are sailing at the rate of seven or eight knots. It can also be used for taking deep-sea soundings, the inclination of the sounding line having no influence on the indications given by the index hands. For the latter purpose, also, a cavity is left at the bottom of the lead designed to be fitted with tallow for the purpose of obtaining specimens showing the nature and formation of the ocean bed.

THEORY OF THE GALVANIC CURRENT.—In a paper on the thermic theory of the galvanic current (*Wied. Ann.*), Herr Hoorweg lays down the following propositions: Wherever two conductors come into contact, motion of heat results in development of electricity; therefore a constant electric difference arises between the two substances. 2. If in a closed circuit, the total sum of the differences of potential be different from zero, there arises in this circuit a continuous electric current. 3. This current exists at the cost of the heat at one part of the point of contact, and has heat-production in the other for a result. 4. All voltaic currents are thermo-currents. 5. The chemical action in the battery and the decomposition apparatuses is a result of the galvanic current.

ON AN AUTOMATIC MERCURIAL PUMP.

By M. G. COUTTOLENC.

THIS apparatus is a mercurial pump, acting in the usual manner, but without cocks; it can also work automatically and indefinitely with the same quantity of mercury. This pump is only intended to complete the vacuum, and works under a pressure of at most 40 to 60 mm. of mercury. As will be seen, a water pump serves to begin the vacuum, provided it is connected to the apparatus by a desiccating tube. The following is the description of the pump: A reservoir capable of a lateral movement of about 0·30 m. is connected with a vertical tube of 0·80 m. At the upper part of the glass tube there is seen first a lateral junction fitted with a valve of a very simple construction, the utility of which will appear further. Immediately above this junction there is cemented a tube of a smaller diameter (0·25 m.) plunging into the former. To this second tube is blown a reservoir pump body of a suitable form, and at the lower part of this is a tube of 0·002 m. in diameter, which forms an elbow and rises perpendicularly, extending some centimeters past the reservoir, where it has an enlargement, and leads at last to the receiver to be exhausted. The upper part of the reservoir pump body ends in a very fine glass tube ($\frac{1}{2}$ to $\frac{1}{4}$ millimeter in internal diameter), which re-descends parallel to the reservoir after a double elbow, and plunges into a small vessel fixed close by. The end of this tube and the vessel are inserted and cemented into a glass reservoir communicating on the one hand with the water pump, and on the other with the valve mentioned at first.

When thus fitted up the apparatus works as follows:

The gas of the instrument being once rarefied by the water pump, the mercury rises in the vertical tube sufficiently to isolate the two concentric tubes. If, at this moment, the movable reservoir is raised up, the mercury ascends first into the lateral junction, where it is soon stopped by the valve, and at the same time into the interior tube; passing before the narrow tube leading to the receiver to be exhausted, the mercury closes it and fills the reservoir pump body, driving out the residual gas by the upper capillary tube. Here it chokes the pipe, returns into the small vessel, and the excess falls on the side of the second reservoir above the valve. If, in the meantime, the movable reservoir redescends, the mercury will leave in the fine tube a column sufficient to close it, and then retiring from the reservoir pump body it produces there a barometric vacuum, which is placed in connection with the receiver to be exhausted, when the mercury unstops the tube leading to it. But at the same time when this effect is produced, the mercury, which had fallen into the other reservoir above the valve, returns into the outer tube. If the movable reservoir is then raised again, the same effects are reproduced, and each time the receiver to be exhausted is brought in connection with the barometric vacuum. The pump works, therefore, by means of a simple up and down movement, which is easily obtained from any source of power.—*Comptes Rendus.*

THEORY OF THE MICROPHONE.

PROFESSOR CHALLIS, in a supplementary paper on the Hydrodynamic Theory of Physical Forces, says: "The theory of the microphone I am about to propose is a corollary from that of the telephone given in the *Philosophical Magazine* for June, 1878. The following mode of producing the phenomena of the microphone, which was conducted in my presence, is convenient for describing the theoretical explanation: An oblong rectangular plate of charcoal of moderate breadth and small thickness was approximately balanced about its middle transverse section, and so placed that the end of its heavier half rested slightly on another plate of charcoal of greater breadth. An arrangement was made by which the electric current pertaining to a telephone could be passed through the two pieces of charcoal. Although my hearing is not good, words transmitted from a distant room were heard with sufficient loudness and distinctness by employing the telephone in the ordinary way and applying a receiving cup to my ear. But as soon as the current was made to traverse the pieces of charcoal the loudness and distinctness were marvelously increased, and I had no longer need to apply the cup. This increment of sound may, I think, be accounted for, on the principles of the hydrodynamical theory of the telephone, in the following manner: The current, in passing out of the narrower into the broader plate, enters into a larger channel, and consequently, according to the hydrodynamics of steady currents, its velocity is there diminished and its density increased. The increment of pressure thence resulting might suffice to raise the narrow plate; but if so, a very slight separation would so far intercept the current as to cause a diminution of the lifting force, and the plate would immediately be brought back by the force of gravity. Thus a quick succession of partial interruptions would be produced whereby the steady motion might be partially converted into vibratory motion. This effect would be precisely analogous to the generation by the siren of Cagniar de la Tour of musical sounds by means of a succession of interruptions of a steady current of air, the pitch of the sound increasing with the velocity of the current. These vibratory motions, being an accession to those produced by the speaker at the transmitting end of the telephone, and having a constant relation to them, are attended by an accession of current, and therefore an accession of effect at the receiving end. This follows from the analytical formula in the second paragraph of the article in the *Phil. Mag.* for June, 1878, the effects under consideration being all referable to pressures depending upon the squares of the velocity of a steady current of the ethereal medium."

MELTING POINTS OF NICKEL.—The determinations were made with the aid of Prinsep's alloys. The melting point of nickel was found to be 1,392° to 1,420°.—*A. Scheriel.*—*Berg u. Hütten Zeitung.*

SUGGESTIONS IN DECORATIVE ART.—COTTAGE PIANOFORTE FROM THE DESIGN OF A. SCHILL, ARCHITECT, BY C. SCHUMACHER, PIANOFORTE MANUFACTURER, STUTTGART.

INTERESTING ELECTRICAL RESEARCHES.

A PAPER was lately read before the Society of Telegraph Engineers by Dr. Siemens, F.R.S., upon "Recent Applications of the Dynamo-Electric Current to Metallurgy, Horticulture, and the Transmission of Power." The author first referred to the inaugural address which he had given before the society on his election to his second presidency, wherein he drew attention to the applicability of the dynamo-electric current to purposes beyond the range of what electricity had theretofore been employed in effecting. On the present occasion he corroborated his statements by a reference to recent experimental results of his own.

The first part of the paper had reference to an electric furnace. This furnace consists of any ordinary crucible of plumbago or other highly refractory material, which is placed in a metallic jacket or outer casing, the intervening space being filled up with pounded charcoal or other bad conductor of heat. A hole is pierced through the bottom of the crucible for the admission of a rod of iron, platinum, or dense carbon, such as is used in electric illumination. The cover of the crucible is also pierced for the reception of the negative electrode, by preference a cylinder of compressed carbon of comparatively large dimensions. At the end of a beam supported at its center is suspended the negative electrode by means of a strip of copper, or other good conductor of electricity, the other end of the beam being attached to a hollow cylinder of iron free to move vertically within a solenoid coil of wire, presenting a total resistance of about fifty units or ohms. By means of a sliding weight the preponderance of weight of the beam in the direction of the solenoid can be varied so as to balance the magnetic force with which the hollow iron cylinder is drawn into the coil. One end of the solenoid coil is connected with the positive, and the other with the negative pole of the electric arc, and, being a coil of high resistance, its attractive force on the iron cylinder is proportional to the electromotive force between the two electrodes, or, in other words, to the electrical resistance of the arc itself.

An automatic adjustment of the arc thus arises of great importance to the attainment of advantageous results in the process of electric fusion; without it the resistance of the arc would rapidly diminish with increase of temperature of the heated atmosphere within the crucible, and heat would be developed in the dynamo-electric machine to the prejudice of the electric furnace. The sudden sinking or change in electrical resistance of the material undergoing fusion would, on the other hand, cause sudden increase in the resistance of the arc, with a likelihood of its extinction, if such self-adjusting action did not take place.

Another important element of success in electric fusion consists in constituting the material to be fused the positive pole of the electric arc. It is well known that it is at the positive pole that the heat is principally developed, and fusion of the material constituting the positive pole takes place even before the crucible itself is heated up to the same degree. This principle of action is of course applicable only to the melting of metals and other electrical conductors, such as metallic oxides, which constitute the materials generally operated upon in metallurgical processes. In operating upon non-conductive earth or upon gases it becomes necessary to provide a non-destructible positive pole, such as platinum or iridium, which may, however, undergo fusion and form a little pool at the bottom of the crucible.

In this electrical furnace some time, of course, is occupied to bring the temperature of the crucible itself up to a considerable degree, but it is surprising how rapidly an accumulation of heat takes place. In working with the modified medium-sized dynamo machine, capable of producing thirty-six webers of current with an expenditure of four horse-power, and which, if used for illuminating purposes, produces a light equal to 6,000 candles, I find that a crucible of about twenty centimeters in depth, immersed in a non-conductive material, is raised up to a white heat in less than half an hour, and the fusion of one kilogramme of steel is effected within, say, another half-hour, successive fusions being effected in somewhat diminishing intervals of time. It is quite feasible to carry on this process upon a still larger scale by increasing the power of the dynamo-electric machine and the size of the crucibles.

It was shown by means of a calculation that this furnace utilizes $\frac{1}{3}$ of the horse-power actually expended, and as the efficiency of a good steam engine is $\frac{1}{5}$, that of the electric furnace is $\frac{1}{3} \times \frac{1}{5} = \frac{1}{15}$. Now, as it takes theoretically 450 heat units to melt 1 lb. of steel, there will be required actually $450 \times 15 = 6{,}750$ units in working with the electric furnace, or about the heat energy residing in a pound of ordinary coal. To melt a ton of steel in crucibles in the ordinary air furnace as practiced at Sheffield, 2½ to 3 tons of best Durham coke are consumed. A ton of coal is consumed per ton of steel produced if the regenerative gas furnace is used for heating the crucibles, while to produce steel in large quantities on the open hearth of this furnace about 12 cwt. of coal per ton of steel suffice. The electric furnace may therefore be considered as economically superior to the ordinary air furnace, and, barring some incidental losses not included in the calculation, is nearly equal to the regenerative gas furnace as far as economy of fuel is concerned. In favor of the electric furnace is an almost unlimited temperature, easy application, a neutral atmosphere within the crucible, and the circumstance that the heat within the crucible is greater than that external to it, whereas in ordinary fusion the temperature of the crucible is higher than that of metal within.

On the occasion of reading the paper a pound of broken files was melted in a cold crucible by means of a current of 72 webers in fifteen minutes, and cast in a liquid state, a second casting being effected in eight minutes. These and other brilliant successes of the new apparatus were hailed with ringing cheers.

In the second portion of the paper, referring to electro-horticulture, the author explained the experiments by means of which he has come to the conclusion that electric light produces the coloring matter chlorophyl in the leaves of plants, that it aids their growth, conteracts the effects of night frosts, and promotes the setting and ripening of fruit in the open air. It appears, further, that, at all events for certain short periods, plants do not require a period of rest during the twenty-four hours, but make increased and vigorous progress if subjected during daytime to sunlight and to electric light at night. These observations on combined sun and electric light agree with those made by Dr. Schübeler of Christiania, who found as the result of continued experiment in the north of Europe, during an Arctic summer, that plants, when thus continuously growing, develop more brilliant flowers and larger and more aromatic fruit than when under the alternating influence of light and darkness. As Dr. Siemens has found that under the influence of electric light plants can sustain increased stove heat without collaps-

ing, he is of opinion that forcing may be effected in an electric stove or inclosure containing an electric light, and that horticulturists may thus grow fruit of excellent aroma and flowers of great brilliancy without immediate solar aid. To test what can be done practically the author has put down a steam engine and boiler at his country residence near Tunbridge Wells, and intends to test the principles involved upon a working scale during the winter. The steam engine which drives the dynamo-electric machine during the night for the purpose of giving light, is to be employed during the day in transmitting power through an electric conductor to the farm for the purpose of carrying on small farming operations, such as turnip, chaff, and wood cutting, etc. Another interesting question which Dr. Siemens has set himself to answer is to determine which portion of the rays constituting white light is efficacious in producing chlorophyl, starch, and woody fiber, and which in effecting the ripening of fruit. For this purpose arrangements are in preparation to distribute the spectrum of a powerful electric light in a darkened chamber over a series of similar plants exposed *seriatim* to the actinic, light giving, and thermal portions of the spectrum. Some experiments have been made with solar light in this direction, but no very conclusive results could be obtained, because the short periods of time during which the solar spectrum can be maintained steadily in the same place are so short that the effects produced upon vegetation have not been of a sufficiently decided character; whereas, with the aid of electric light, the same spectrum may be kept on steadily for a series of days without intermission. The author referred shortly to the lamp which he designed for this purpose, having a focus unchangeable in space, and without obstruction to the rays of light falling downward. There is no clockwork; the carbons are pressed forward either by their own weight or by the force of springs, the motion being checked by an abutment against which the carbon presses at the junction of its cylindrical with its conical portion. This is at a distance of ¼ inch to ¼ inch from the arc center, when the heat is sufficient to cause the gradual decomposition of the carbon, without being high enough to fuse or injure the metal abutment.

In the third portion of the paper the author refers to the application of electricity as a means of mechanical propulsion. He described the electric railway designed by Dr. Werner Siemens, of Berlin, and tried at a local exhibition held in that city. The rails were insulated from the earth by wooden sleepers, and were in electrical connection with a dynamo-electric machine worked by steam power at the station. A magneto-electric machine on the driving carriage was so fixed and connected with the axle of one pair of wheels as to give motion to the same, the driving axle being severed electrically by the introduction of an insulated washer. A current of electricity is thus passed along one rail to work the magneto-electric machine on the driving carriage, and back by the other rail to the stationary machine on the ground. The author anticipates a large application of the electric railway to adits in mines, to locomotives between neighboring places, and to tunnels. In fact it is seriously contemplated to apply this system at the St. Gothard tunnel, where the large turbines are available which have been employed in the boring operations.

DEVELOPMENT OF THE LATENT PHOTOGRAPHIC IMAGE.

By M. CAREY LEA, Philadelphia.

ON SUBSTANCES POSSESSING THE POWER OF DEVELOPING THE LATENT PHOTOGRAPHIC IMAGE.

ABOUT three years since, I communicated to this journal the results of a long series of studies on development. At the time when these were undertaken there were but four substances known to possess the power of development: ferrous sulphate, gallic acid, and pyrogallol, which had been long known to have this property, and hæmatoxyline, which I had some years before added to the number.

The studies made three years ago prove that the power of development, so far from being possessed by this small number of substances only, extends to a large number of chemical compounds, and is exhibited by many cuprous salts, by several vegetable acids, glucosides, etc. But the most curious result obtained was with ferrous salts. It was known that ferrous sulphate, though a powerful developer in the so-called "wet development," *i. e.*, development in presence of a soluble silver salt, had no power whatever for those developments in which no soluble silver salt was present, and where the development was to be made at the expense of the film itself. I was able to show that ferrous oxide combined with almost any organic acid, possessed this power of forming a visible image at the expense of the film. So that a solution of ferrous sulphate by mixing with one of an alkaline oxalate, succinate, salicylate, etc., immediately acquires the power of development. Ferrous oxalate exhibits the power of development to a degree so remarkable that it seems likely to displace the older methods.

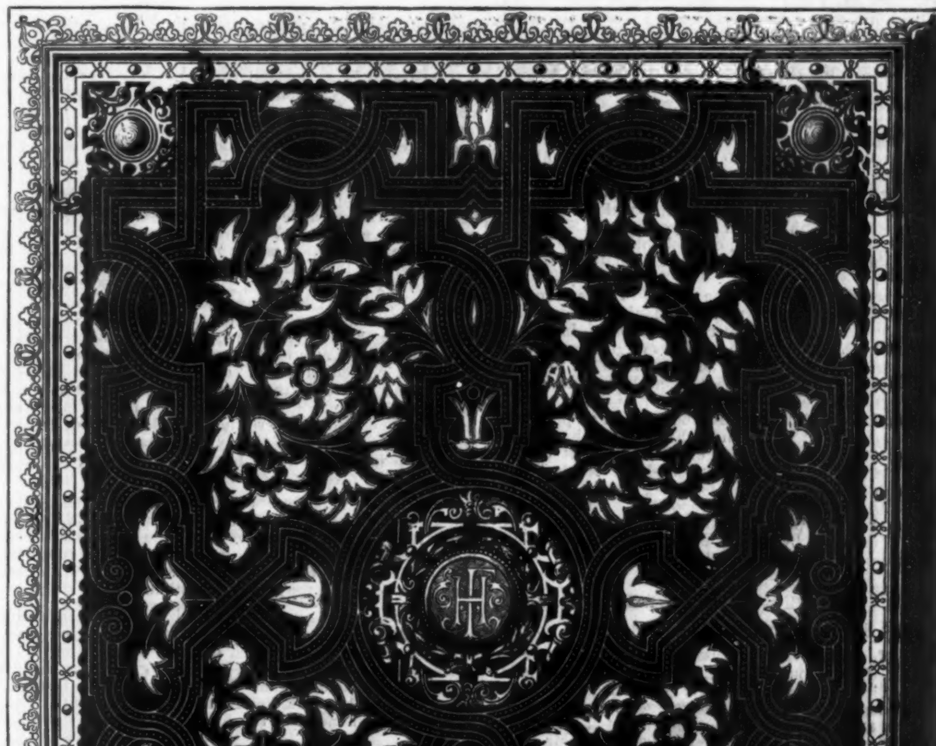
The study of the subject was resumed during the past winter, and with the result of ascertaining that this power of developing was not limited to the organic salts of ferrous oxide, but was possessed by many of its inorganic compounds. It certainly has never been suspected that such compounds as *ferrous phosphate, ferrous borate, ferrous sulphite, ferrous hypophosphite*, etc., possessed the power of development, but this they undoubtedly do, and not in any uncertain way. On the contrary, some of these compounds are among the most powerful of all known developing agents, equaling, or possibly even exceeding, ferrous oxalate in this respect, so that it is far from impossible that some of them may pass into technical use in preference to those now employed.

Some of these ferrous salts, especially the phosphate, sulphite, and borate, are, like the oxalate, insoluble in water, and therefore need to be got into solution. As these salts are not, like the oxalate, soluble in the corresponding alkaline salt, at least not to any useful extent, it becomes necessary to find an appropriate solvent. The most available solvents are solutions of ammonium and potassium oxalate, and of ammonium and sodium tartrate. Of these, the first have the material advantage that the ferrous salts remain permanently in solution, whereas with ammonium and sodium tartrate they are apt gradually to be precipitated.

As ferrous oxalate is a powerful developer, the question immediately presented itself whether the developing power exhibited, for instance by ferrous phosphate dissolved in ammonium oxalate, might not be due to the formation of ferrous oxalate. But several reactions contradict this supposition. When a hot solution of ammonium (neutral) oxalate is fully saturated with ferrous phosphate, a precipitate separates in cooling, and this precipitate is not ferrous oxalate but ferrous phosphate. Again, ferrous phosphate exhibits powerful developing properties when dissolved in sodic or ammonic tartrate. This reaction is, however, not in itself decisive, inasmuch as I find that ferrous tartrate has itself developing properties. But as ferrous phosphate is to some extent soluble in a solution of ferrous sulphate, and as ferrous sulphate (in the form of development here under consideration, namely, in the absence of soluble silver salt) is wholly without developing power, an opportunity offered itself of testing the question. And it proved that a solution obtained by adding one of disodic phosphate to one of ferrous sulphate until a permanent precipitate began to form, undoubtedly possessed developing powers, though in a less degree.

The number of ferrous salts capable of developing the latent image is very considerable. Singular anomalies are often shown; a given salt prepared in one way may develop, while prepared in another it may have no such power. Nor is it possible to form an opinion beforehand as to whether a given compound of ferrous oxide will exhibit this power or not; compounds nearly allied do not exhibit analogies in this respect. For example: ferrous phosphate and ferrous meta-phosphate are active developers, while ferrous pyrophosphate has no similar power.

Among other ferrous salts possessing more or less developing power, may be mentioned ferrous hyposulphite (hydrosulphate), ammonio-chloride, acetate, antimonio-tartrate, etc. Ferrous formiate, which might naturally be expected to be a powerful developer, is almost, though not entirely, destitute of the property. The most active agents found were ferrous borate, phosphate, sulphite and oxalate,



COVER IN LEATHER MOSAIC.—DESIGN OF IHNE AND STEGMULLER, BY COLLIN, BOOKBINDER, BERLIN. ½ REAL SIZE.—FROM THE WORKSHOP.

respectively dissolved, the phosphate in neutral ammonium oxalate, the others in neutral potassium oxalate.—*American Journal of Science and Arts.*

TRANSFER OF NEGATIVES.

M. ARENTZ described, at the last meeting of the Photographic Society of France, an ingenious process for transferring negatives which he had for some time worked in the studio of M. Dujardin. There are many processes of this kind already in existence, but this one by M. Arentz can be recommended as being both simple and expeditious.

In order that my readers may have an opportunity of trying this process and of satisfying themselves of its superiority to others of the same kind, I give a short account of it. Let me premise by saying that the whole operation of removing the pellicle of collodion from the glass plate and transferring it to some other support need not occupy a longer time than a quarter of an hour. In the first place a solution of three grammes of manufactured caoutchouc in one hundred of benzine is made and carefully filtered; next, raw collodion must be prepared of the same density as that used for taking the negative. The plate having been retouched when necessary, but not varnished, is then coated with the caoutchouc varnish, after the same fashion as it would be originally coated with collodion, and is placed to drain and dry for a few minutes. Afterwards, when the benzine has sufficiently evaporated it is collodionized over the caoutchouc varnish with the raw collodion, and again left for a little while to dry; the film is then cut with a penknife all round the edge of the glass to the size required. Two pieces of any kind of paper are next taken of the same shape as the plate, but of slightly larger dimensions than those of the pellicle when removed from the plate, and one of these pieces is plunged into a basin of water; it is placed, still wet, on the film. With a roller formed of a cylinder of wood inserted in a piece of India-rubber tubing, the damp paper is made to adhere to the film; when now a corner of the paper is turned back and the corresponding corner of the film carefully raised with the blade of a penknife and turned over it, the whole paper, by a slow but continuous motion, may be pulled off the glass, bringing the collodion pellicle with it.

We have thus the negative removed from its original support and stretched on the surface of a sheet of paper, to which it adheres by reason of the humidity of the latter. In this state it could be left to dry, and could then be used in its pellicular condition; but if it be desired to simply invert the negative while keeping it attached to the glass, the second sheet of paper above mentioned must be taken and wetted in the same way as before. The first sheet, with the pellicle attached, is then placed on a glass plate, the pellicle being upward, the second sheet laid over it, and the superfluous moisture pressed out with a roller.

By the same manipulation as in the former case, the second sheet of paper may be stripped off, bringing with it the negative in its original position. A glass plate is then coated with a solution of gum-arabic in water, the negative on its paper support is placed over it and pressed on to it with the roller; the paper is again removed, and the pellicle remains adhering to the glass, but the negative is in a reversed position. It is better to do without the varnish, because, as it shrinks in drying, it causes the negative to wrinkle; besides, the surface of the plate is quite hard enough without the varnish to resist any rubbing. The reversed negative is not quite so large as the original plate; it shrinks about the millimeter in every thirty-two centimeters of length. M. Arentz states that, by this method, he can also transfer films of gelatino-bromide, a fact of great interest now that the gelatine plates are coming more and more into use.

INFLUENCE OF FATTENING ANIMALS UPON THE CONSTITUTION OF THE FATS FORMED IN THEIR TISSUES.—As animals are fattened, their fats become more fusible and contain a smaller proportion of solids. Hence they possess a lower industrial value.—*A. Muntz.*

DEVELOPING GELATINE PLATES.

By W. BOVEY.

MY enthusiasm in photographic research having lost the sanguine impulse of youthful ardor, I am humbly content to introduce my present mode of developing gelatine dry plates as a modestly slight modification of the generally adopted method, inasmuch as I discard the use of bromide, and regulate the amount of pyrogallic to suit exposure and the quality of the gelatine plate. As is, unfortunately, too frequently the case, gelatine plates lack uniformity.

With plates that are prone to over-intensity, I reduce the pyrogallic as low as one grain to an ounce of water. For thinly-coated plates I use five or six grains of pyrogallic to an ounce of water. To reduce the matter to rule, however, I will imagine the plate perfect in all respects; in such case I would prepare my developer as follows:

Pyrogallic....	about 2 grains.
Water..	1 ounce.

Exposure—About one-tenth the time required for an ordinary wet collodion plate. After exposure, place the plate in a dish larger than the plate. For a 7¼ by 4½ inch plate, I use a 10 by 8 glass bottom dish or tray. Flood the plate with the pyrogallic solution, then tilt the dish to collect the solution at one end. A few drops of ammonia solution, prepared as follows, must now be added:

Ammonia fort	2 drachms.
Water....	8 ounces.

The highest lights will shortly appear; these must be permitted to obtain some force before adding more ammonia to bring out the middle tones and details of shadows. The image should appear with exaggerated intensity as seen by reflected light, but care must be taken that in this state gradation of strength is duly preserved. A few trials would suffice to enable the operator to control the development. Keep the pyrogallic in excess, and guide with gradual additions of ammonia, which in weak solution can be used without fear that a drop or two more or less can do much harm.

I intensify weak images, when such chance to turn up, with B. J. Edwards's excellent formula, to which I add quite half more of hyposulphite than he recommends. This addition makes the intensification controllable, and the color it yields resembles that produced by the less reliable pyrogallic re-developer.

I have given the plan as above stated to several of my customers and other friends, who are unanimous in praising its simplicity and comparative certainty in correcting varied exposures. In the hope that my readers might benefit from the information also, I gladly add my mite to the fund which has been contributed to so liberally by admirers of gelatine dry plates.

In conclusion I will briefly describe a mode of preparing a non-actinic medium which has cheapness and thorough reliability to recommend it for general use—stout orange-colored paper, sold at one penny per sheet, brushed over one side with a liberal coating of aurine, then dried. Mix sweet oil with paraffin, in equal proportion. Rub this well into the paper with a piece of flannel, and you have a semi-transparent medium, by which dry gelatine or wet plates may be developed with safety.—*Photographic News.*

SIEMENS-MARTIN STEEL.

By SERGIUS KERN, M.E., St. Petersburg.

THE chief steel works in Russia are situated near St. Petersburg. The Obouchoff Steel Works have erected lately two 10-ton Siemens-Martin furnaces. The furnaces have no muffles for heating previously the charges introduced into the furnace, and the mode of working adopted here differs from the Terre-Noire method, as described by Mr. A. L. Holley. The author desires to give a short description of the *modus operandi* and a full account of some charges. The charge consists of steel scrap, ladle scrap, and manganese pig iron. A pig containing 9 to 12 per cent. of manganese is ordinarily used. It is well known that big cast-steel ingots have a piping in their top part; and as such a part is of no use for forgings, therefore a certain part of the ingot, when forged into the required shape, is always cut off under the steam hammer. Such ends are also used for the Siemens-Martin furnace. Very often ends weighing about 2 to 2¼ tons are introduced among other steel scrap in the cold state into the furnace.

During the process of charging the furnace is kept as hot as possible. All the required materials, viz., pig iron, steel scrap, and ladle scrap (about 8 tons altogether) are charged at once, and no additional charges are introduced after the metal is in a melted state, save if the testing of a sample out of the furnace shows that the metal is too hard; then, ordinarily, some 15 to 20 cwt. of good puddled iron blooms are introduced into the metallic bath. The blooms are left for some time on the banks of the furnace doors, and when well heated are thrown down into the metallic bath. But it has been found to be cheaper and quicker, in order to soften the metal, to introduce some 2 to 5 cwt. of good magnetic iron ore in the form of a fine powder. The steel tests taken afterward soon show that the steel has turned mild; but if it happens that even then the steel is not so soft as desired, another charge of 3 to 4 cwt. of magnetic ore with 1 cwt. of ferro-manganese quickly brings the steel to the desired softness. Certainly, much depends on the state of the gas and on the quality of the materials, but with a well-going furnace and good materials the above holds good.

Before the casting, if soft steel is wanted, ½ to 1 cwt. of ferro-manganese is added, and for harder steel, containing 0·50 to 0·65 per cent. of carbon, often 3 to 10 cwt. of spiegeleisen is the additional charge. As there is no handy direct process to ascertain the amount of carbon in the samples taken out of the furnace, the engineer is often in a difficulty in calculating the amount of the last charge of ferro-manganese or spiegeleisen to be introduced into the metallic bath. A very good test is the following: The sound part of a sample is heated to light welding heat, and hammered to the following dimensions (approximative): $5'' \times 0{\cdot}5'' \times \frac{5}{16}''$. This small bar, cooled slowly in ashes or sand, must bend nearly double, and if it stands the test tolerably well, it may be supposed to contain not more than 0·25 to 0·30 per cent. of carbon. The sample after being drawn, by hammering before being cooled, as mentioned above, must be reheated to a red heat.

The following charges give an idea of the mode of working:

Hard Steel.—Charge: Steel scrap, 120 cwt.; ladle scrap, 17 cwt.; pig iron, containing 12 per cent. of manganese, 17 cwt.; all charged at once; charging commenced 4:30 A.M., finished 6 A.M. Melted and one sample taken out 8:15 A.M.; 17 cwt. puddled iron blooms charged 9 A.M.; sample hammered well, cooled, bent double; 15 cwt. pig iron, containing 9 per cent. of manganese, charged 10:20 A.M.; casting took place at 11 A.M. Analysis of the steel: carbon, 0·67; manganese, 0·40 per cent.

Medium Steel.—Charge: Steel scrap, 135 cwt.; ladle scrap, 23 cwt.; pig iron, containing 12 per cent. of manganese, 10 cwt.; charging commenced 1 P.M., finished 2:45 P.M.; melted, 0·5 cwt. ferro-manganese added, and first test taken 7:40 P.M. The steel was hard; 2·5 cwt. of magnetic iron ore added 7:55 P.M.; test taken 8:30 P.M.; sample bar bent nearly double, given only a slight crack; 0·5 cwt. of ferro-manganese added; casting 9:15 P.M. Analysis of the steel: carbon, 0·35; manganese, 0·18 per cent.

Soft Steel.—Charge: Steel scrap, 113 cwt.; ladle scrap, 26 cwt.; pig iron, containing 12 per cent. of manganese, 6·5 cwt.; charging commenced 11 A.M.; finished 12:30 P.M. Melted and first test, 6 P.M.; 2 cwt. ferro-manganese added 6:30 P.M.; test bar bent double after being hardened; ½ cwt. ferro-manganese added 7 P.M.; casting, 7:15 P.M. Analysis of the steel: carbon, 0·16; manganese, 0·14 per cent. The steel was prepared for boiler plates.—*Chemical News.*

ON THE ELECTROLYTIC DETERMINATION OF METALS.

By LUDWIG SCHICHT.

THE author's researches refer to the metals of the group uranium, thallium, indium, and vanadium, and to the group molybdenum, selenium, and tellurium. Uranium is not precipitated from its solutions in mineral acids, but by the secondary action the effect of the nascent hydrogen uranic oxide is reduced to uranous oxide. From neutral solutions it is separated in very small quantities, of a yellow color. Alkaline solutions containing organic acids (tartaric, citric, acetic), or mixed with sugar, deposit likewise very small quantities of uranium. The precipitated uranium does not readily re-dissolve in dilute acids. Sulphuric and nitric solutions of thallium were prepared from the pure metal. The acidulated solutions were not precipitated by the current. From ammoniacal solutions metallic thallium was deposited at the cathode with a brisk disengagement of gas, whilst at the positive pole there appeared blackish brown thallium oxide, much resembling lead peroxide. For the decomposition the author used at first the current from 4 Meidinger Pincus elements, giving hourly 160 c.c. of detonating gas, but this was found too strong, as the thallium was deposited in a spongy state and of a darker color. On using two or three elements fine, permanently adhesive metal was obtained. From neutral solutions the metal is imperfectly precipitated on account of the acid which is liberated. In alkaline solutions the separation is complete, and the metal is bright and solid. It re-dissolves readily in sulphuric acid. The oxide dissolves in hydrochloric acid, evolving chlorine. Indium is completely precipitated as metal at the negative pole, both from acid and alkaline solutions; in the latter case the metal is very bright and firm.

Vanadium.—Vanadium chloride was dissolved in water containing hydrochloric acid and electrolyzed. No precipitation took place in the blue solution, the vanadic acid being merely reduced to oxide. Sulphurous acid, organic acids, etc., reduce merely to vanadium tetroxide, V_2O_4. The same reduction occurs in the alkaline solution.

Palladium.—The nitrate, dissolved in water and acidified with a little nitric acid, deposited at the negative pole a bronze-colored coating, which on continued action of the current became darker, and finally black. It re-dissolves easily in nitric acid. Some reddish oxide was formed at the positive pole. Alkaline solutions of palladium behave in a similar manner, but the deposition is slower and more adhesive.

Molybdenum is precipitated from the ammoniacal solution of molybdic acid as molybdous oxide, which appears at the negative pole at first in colored rings, which gradually thicken and become blue-black. The first blue precipitation is molybdic molybdate; then follows molybdic oxide and molybdous oxide. The precipitation is complete and adheres very firmly. In acid solutions there is no precipitation; in ammonium molybdate acidified with free molybdic acid the precipitation is imperfect.

Selenium is readily and completely reduced and thrown down, both from acid and alkaline solutions. The current should not be strong (two elements) or the deposit is pulverulent. In order to determine selenium electrolytically it is oxidized by boiling with nitric acid, and the solution of a metal is added, which occasions the separation of the selenium in a solid combination. A solution of copper is suitable for this purpose.

Tellurium behaves like selenium, but it is reduced much more readily. From an acid solution it is easily deposited with a blue-black color. From alkaline solutions it is thrown down in a very loose state at the positive pole, with strong disengagement of gas. If much metal is present it floats on the surface of the liquid.

Gallium, like zinc, is thrown down completely at the negative pole in a pure state.—*Berg und Hüttenmannische Zeitung.*

THE BEHAVIOR OF SULPHURETED HYDROGEN WITH THE SALTS OF THE HEAVY METALS.*

By H. DELFFS.

THE author called attention to the different precipitability of the metallic salts in presence of a strong mineral acid on the one hand, and of acetic acid on the other. Just as the limit between precipitable and non-precipitable salts is altered by the use of acetic acid instead of hydrochloric acid, it is further modified if formiates are treated with sulphureted hydrogen. In that case the salt of zinc is precipitated, but the compounds of cobalt, nickel, iron, and manganese are not affected. Manganese cannot be precipitated by sulphureted hydrogen from propionic, butyric, and valerianic solutions. In precipitations by this last reagent several metals are never simultaneously converted into the corresponding sulphides, but the precipitation ensues in such a manner that one metal is first completely separated before the removal of another begins. Upon this fact is founded a very convenient method for obtaining cobalt and nickel in a state of purity. As sulphureted hydrogen first completely precipitates cobalt acetate, and then acts upon nickel acetate, a solution of the two nitrates is mixed with sodium acetate in quantity insufficient for complete double decomposition, and sulphureted hydrogen is introduced, so that, according to the respective proportions of the two metals, either nickel free from cobalt is obtained in solution or cobalt free from nickel as a precipitate. The required quantity of sodium acetate may be calculated from the relative quantities of the two metals which are mostly known. The more electro-positive a metal the later it is precipitated from a mixture of its salts with those of other metals, and thus a series of "chemical tension" may be established which, on account of the electromotoric action of the liquids, does not always agree with the series of "physical tension."

* A Paper read before the Chemical Section of the Congress of German Naturalists and Physicians, at Baden-Baden, Sept. 19, 1879.

DETERMINATION OF ZINC.

By W. ALEXANDROWICZ.

THE separation of zinc from the metals of the copper and the iron group presents considerable difficulties. The quantity of zinc thrown down along with copper by sulphureted hydrogen is not appreciable if the solution is sufficiently acid. Where great exactitude is required, a double precipitation is recommended.

The complete separation of cadmium and zinc by means of sulphureted hydrogen is impossible, especially in presence of copper. In separating arsenic from zinc, if the solution is distinctly acid, the zinc is not thrown down by sulphureted hydrogen.

In separating iron and zinc the author recommends that the solution of the mixed metals should be poured drop by drop into the ammonia, and not *vice versa*. The zinc remains in solution. The precipitate is then washed with ammoniacal water.

In separating manganese from zinc the author acidifies with acetic acid and precipitates with sulphureted hydrogen. All the manganese remains in solution.—*Revue Universelle des Mines.*

METHYL CHLORIDE.

METHYL chloride, or the hydrochloric ether of methylic alcohol, is represented by the formula $C_2H_3Cl=50{\cdot}5$. It is gaseous at common temperatures, possesses an ethereal odor and a saccharine taste; its specific gravity is 1·738 (air=1·0 at 0°). The weight of a liter of this gas=2·261 grammes. Water dissolves 2·8 vols. methyl chloride at 16° and under a barometric pressure of 0·765. Glacial acetic acid dissolves 40, and absolute alcohol 35 vols. under the same conditions. Methyl chloride burns with a white flame edged with green, forming water, carbonic acid, and torrents of hydrochloric acid gas. If methyl chloride is compressed, it is easily converted into a colorless and highly mobile liquid boiling about —23° under the normal pressure of 0·760 m. The slight vapor tension of this product renders its liquefaction, its management, and its carriage easy. Thus the total tension of its vapor is at—

0°........	2·48	atmospheres.
+15°....	4·11	"
20°..........................	4·81	"
25°	5·62	"
30°............	6·50	"
35°...........	7·50	"

From these figures, one atmosphere must be deducted to find the pressure really exercised upon the vessels containing the liquid.

Hitherto chloride of methyl, as prepared by the mutual reaction of common salt, sulphuric acid, and methylic alcohol, has not been suitable for industrial applications on account of the difficulty of preparing it in a state of purity at a moderate price. Quite recently M. Camille Vincent has made known a process which enables it to be procured in abundance and free from impurities.

This process consists in heating the hydrochlorate of tri-methylamine which is obtained industrially from the refuse of beet root. The hydrochlorate of tri-methylamine is thus decomposed into free trimethylamine, ammonia, and methyl chloride. Washing in acid water removes every trace of alkali, and the dried gas may then be liquefied by compression. The product thus obtained, perfectly pure, is manufactured on the large scale by MM. Brigonnet & Son, at Saint Denis.

USES OF METHYL CHLORIDE.

As a frigorific agent, methyl chloride may be employed either in the laboratory or in manufactures. If it is allowed to issue into an open vessel, it enters into a brisk ebullition for a few moments. Its surface then becomes tranquil, forming a bath at —23°, into which the objects to be refrigerated may be plunged. If the evaporation is intensified by the injection of dry air, the temperature of the bath may be reduced to —55° in a few minutes, so as to freeze mercury. M. Vincent has designed a small apparatus for the laboratory in which a bath of one liter of an incongealable liquid (*e. g.*, alcohol) may be kept for some hours at a temperature of —23°, or of 50—55°. It is composed of a cylindrical vessel of copper with double walls.

M. Vincent has also constructed a more complete apparatus, suitable either for experimental or domestic purposes, and so arranged that the methyl chloride may be recovered. Large machines are also made adapted for cooling water, air, etc., on the great scale. They have the advantage of employing, as vehicle of heat, a neutral liquid incapable of attacking metal work and free from poisonous or offensive unexplosive properties.

It must be remembered that the chloride of methyl can be used in any machine for the production of ice with the exception of those constructed to work with liquid ammonia.

PREPARATION OF METHYLIC PRODUCTS.

Methyl chloride is a product which offers great advantages to the manufacturers of coloring matters derived from coal-tar. It may serve in the manufacture of colored or colorable products in which methyl plays any part soever, such as methylaniline, methyldiphenylamine, methyltoluidin (which yields a red violet, Hofmann's violet, methyl-green, methylic eosin, etc).

It is an advantageous substitute for the other methylic compounds commonly employed, such as methyl bromide, iodide, and nitrate, the two former of which are costly and the latter dangerously explosive. Liquefied methyl chloride being a pure and anhydrous compound, is well adapted for exact operations which lead to perfect regularity in the quality of the product.

The methylated compounds which have been already prepared with liquid methyl chloride are diamethylaniline, methyldiphenylamine, Hofmann's violet, and methyl-green. We will briefly describe the preparation of the two latter according to the process of MM. Monnet and Reverdin, of Laplaine, near Geneva.

To obtain green with methyl chloride, we place in an autoclave a solution of methylaniline violet in methylic alcohol rendered basic by the addition of soda. The ap-

paratus is closed and a known quantity of methyl chloride is introduced by means of the manipulation already described. The autoclave is placed in a water bath heated by a jet of steam and the temperature is raised to four or five atmospheres. When the reaction is complete, the hot water is let out and its place is taken by a stream of cold water, the excess of pressure being destroyed by slackening the screw of the cock.

The produce of the reaction is heated with an alkali and filtered to separate the base of the violet: the filtrate containing the base of the green is treated with an acid and a salt of zinc, to form the corresponding double salt of the green and of zinc, and the coloring matter is then precipitated by common salt. by substituting in the preceding operation rosaniline for methylaniline violet we obtain Hofmann's violet.

DETERMINATION OF CHLORINE.

By G. VORTMANN.

THE author has discovered a method by means of which even small quantities of chlorine along with the other halogens can be easily and quickly detected. It depends on the different behavior of the chlorides, bromides, and iodides with peroxides of manganese and lead in presence of acetic acid.

Iodides are partially decomposed by the above-mentioned peroxides, even in neutral solutions, and if they are boiled with the addition of acetic acid the iodine is completely eliminated. Lead peroxide oxidizes a part of the iodine to iodic acid, but with manganese peroxide no iodic acid is formed

In a neutral solution bromides are not decomposed either by manganese or lead peroxide. In an acetic solution the lead peroxide only acts, bromine escapes, but bromic acid is formed only if bromides are present in considerable quantities. Manganese peroxide has no action in the acetic solution, even on prolonged heating.

Chlorides are not attacked by either of the peroxides in presence of acetic acid. In testing for chlorides in presence of bromides or iodides it is sufficient to boil the substance in an acetic solution with lead peroxide till the liquid on settling is colorless, and has not the slightest odor of bromine or iodine. The bromine and a part of the iodine escape as such; the remainder of the iodine remains as lead iodate along with the excess of the lead peroxide. On filtering and washing the precipitate, all the chlorine is found in the filtrate free from bromine and iodine. In this manner the chlorine may be determined quantitatively. If the quantity of chlorine accompanying the iodine is considerable, manganese peroxide is preferable to lead peroxide, as otherwise the liquid must be largely diluted with water to prevent lead chloride from depositing. In determining large quantities of chlorine in presence of bromine, it is well to add along with the lead peroxide some potassium sulphate so that all the chlorine may be found in the filtrate combined with potassium.

In order to expel the liberated bromine and iodine more rapidly, a moderate current of air may be passed through the solution on the water bath.—*Berichte der Deutschen Chem. Gesellschaft.*

ANALYSES OF SOME HAIR DYES.

By J. F. BRAGA.

BEING solicited to ascertain for some clients in Portugal the general composition of the various hair dyes largely sold and, I suppose, used in England, I have from time to time submitted specimens to analysis; the results may be of some interest to your readers.

The dyes may be classified as those for making the hair dark and those for making it light, though this latter operation consists in bleaching, not dyeing, the hair.

For making the hair light I have found that the material used is peroxide of hydrogen, sold under numberless fanciful names, and usually at extravagantly fanciful prices. It is perfectly harmless to the hair, its action being limited apparently to the oxidation of the coloring matter. It appears to be without action upon "red" hair, other materials, such as permanganate of potash, dilute nitric acid, and strong ammonia, exercising a more or less bleaching effect, and, though destructive to the hair, have been sold; but they appear to have been completely displaced by the peroxide of hydrogen.

The substances used for making the hair dark, the true dyes, seem, so far as my experiments go, to be limited to solutions of lead, silver, and copper.

Of the lead solutions, that of the hyposulphite is about the best. I found the sample I analyzed had been prepared by mixing acetate of lead with an excess of hyposulphite of soda, the solution containing glycerine and a little alcohol. After accurately determining the amount of lead, and approximately the amounts of the other constituents, I successfully imitated the original by the following formula:

Acetate of lead	5·7 grms.
Hyposulphite of soda	11·5 grms.
Glycerin	50·0 c.c.
Spirits of wine	100·0 c.c.
Distilled water	850·0 c.c.

The salts being separately dissolved, and the glycerine and alcohol mixed with the hyposulphite, the solution of lead was then gradually poured into the mixture. The resulting compound should be kept in the dark.

Another consisted simply of a solution of oxide of lead and glycerine, with precipitated sulphur in suspension; its composition being:

Oxide of lead	17·0 grms.
Glycerine	300·0 grms.
Water	to 1 liter.
Precipitated sulphur	17·0 grms. in 1 liter.

A third closely resembled this, being composed as follows:

Acetate of lead	12·5 grms.
Glycerine	125·0 grms.
Distilled water	to 1 liter.
Precipitated sulphur	10·0 grms.

This was stated to be unsatisfactory in its action. The last which I shall mention of the lead dyes consisted of a very dilute solution of lead in caustic potash. I was enabled to imitate it after analysis by dissolving 1·25 grms. of acetate of lead in hot water, and adding thereto a hot freshly-prepared solution of caustic potash until the precipitate at first formed *just* redissolved, and then diluting that solution up to 1 liter.

The perfume of these liquids is due to the employment of scented waters, prepared either by distillation or after an alternative method, such as that given in the Pharmacopœia.—*Chemical News.*

SCARLET FEVER.*

THE next topic that will engage our attention is scarlet fever, and I have a curious fact to disclose to you in regard to its prevalence. I have already told you that we have bills of mortality running back to 1804, regularly kept. The disease of which each person dies is recorded, and the number of cases is easily summed up. From 1804 to 1828 the number of deaths from scarlet fever occurring in this city was very small, the whole number being only 111. Then came a sudden invasion of the disease. In 1829 there were 188 deaths—a number in that year greatly exceeding the whole number of deaths for the twenty-five preceding years. And from that time until now it has held on at a pretty high rate of mortality year by year. For the next year, 1830, the number of deaths from scarlet fever was 246; for the succeeding years in their order, 258, 221, 179, 418, 174, 202, 579, 257, 158, 391, 416, 223, 224, 63—that was in 1844, which is a small number for that period—115, 142, 93, and so on. And that large mortality has continued to the present time. In 1877 there were 815 deaths from scarlet fever. Well, of course, you expect some increase in the number of deaths from the increase in the population, and in the advancing years and accumulating people it will be necessary to make an average—an equality of death proportioned to the number of inhabitants. But even making that reckoning, the scarlet fever mortality has increased a good deal faster than the population of New York has increased.

Scarlet fever has its several periods, as small-pox has. It has its period of incubation; is strictly a contagious disease. The poison dwells in the system a certain length of time before it manifests itself in symptoms. Then, it has its invasion, it has its eruption, its desquamation, and its sequelæ.

In regard to the period of incubation of scarlet fever, it seems to be very variable. I have acquired a considerable number of facts bearing upon that point. The one that I most commonly cite is that of a family in Woodstock, Vermont. When I was lecturing at the Vermont Medical College, I saw several children sick in the family of a man named Cobb. The history was this: There had been no scarlet fever in the town of Woodstock for a great many months, and this man Cobb took his wife and three children on a visit twelve miles from Woodstock in the town of Plymouth. When he reached his friend's house he found scarlet fever in the family, but he allowed his family to remain there two nights, the night of their arrival and the night following. He entered this house on the evening of the 16th of March. He returned home, and one of the children that had made this visit with him was taken sick with scarlet fever on the evening of the 19th—three days after the exposure. Another was taken on the 20th, and then the cases that followed seemed to have been propagated from those that made this visit, and they occurred at about three days' interval. But several children, five in number, were all taken down with the disease—the infant, which was one of the visitors at Plymouth, the last of all. The two sons that remained at home were attacked, one of them on the 23d, and the other on the 26th. They must have taken it from those children that had it developed in them from the contagion received at Plymouth, and in them the period was three days in one and six days in the other, or three days in both, depending upon how the second of the boys who remained at home took his disease. It is reported in Murchison's that it is developed in symptoms in very few hours.

I have another case derived from the same town, that is instructive on the other side of the question. A girl, a daughter of a man in Woodstock, had been in one of the factories of New Hampshire at work, and boarded in a family where scarlet fever broke out. Pretty soon after scarlet fever appeared in this family she returned home, and nine days after she left the house she had scarlet fever, and she communicated it to two of her brothers, who took it, each four days after the other. Four days after the eruption appeared in this young woman, it appeared in one of her brothers; and four days after that in the other of her brothers. Now, we cannot say whether this was an incubation in the last of four or eight days, for we do not know whether he took it from his brother or from his sister. Four days is not an uncommon period of incubation, and then it is reported to run on to fifteen, or even thirty days, but this longer period I think requires new investigation. I doubt whether it will dwell in the system so long a time, and then, there is a chance for other exposures when the time is protracted. It is pretty clear then, that it has a varying incubation; you may say, perhaps for safety, from a few hours to fifteen days.

With reference to the invasion, that is a short period. The period of invasion of small-pox, as I told you, is two full days, and pretty regularly. The period of invasion of scarlet fever, that is the fever before the eruption, sometimes is not over six or seven hours, and it rarely exceeds twenty-four. The invasion is various. In a few children it is attended by convulsions, but in much the greater number it is a febrile action—not necessarily preceded by a chill, or perhaps even commonly. It is attended with a great deal of vomiting. A febrile action attended by vomiting in a child may always be suspected, and all the more if any exposure is known. The vomiting, I cannot say, is absolutely constant, but it occurs frequently enough to be a very valuable symptom in diagnosis. The eruption then occurs, say from seven to twenty-four hours after the invasion, and it appears first upon the forehead and neck, and just the upper part of the chest. It has a progress downward, so that it requires in some instances nearly two days to reach the feet. It is apt to affect the whole body, the different parts of it successively.

I have seen cases of scarlet fever that broke out first upon the limbs, but they are not very common. I have seen them also in which the eruption was general at once, but the rule is, as I have stated to you, that it appears first upon the upper part of the body—on the neck, head, and face—and advances downward. The peculiar kind of eruption is that you see on this plate, a reddening of the whole surface affected. And yet it begins in patches. The patches spread until one reaches another, and the eruption becomes general. There is with the eruption, not infrequently, a little blister; several together called sudaminæ; little elevations that will suggest to you the idea of glass having been broken and some fine portions of it having been left on the skin. The eruption varies, however, so much that you will often be puzzled to know whether you have got scarlet fever to treat or not. In some instances it is the merest blush; you can hardly say there is anything. In other instances it is well marked, as in the figure that I have shown you. And in addition to that, in certain cases where the eruption is full, there will appear a little œdema, a little swelling of the face, a little swelling of the neck, and of the several parts of the body successively invaded by the eruption. The eruption, however, is not the whole of the disease.

Scarlet fever has been divided into scarlatina simplex, scarlatina anginosa, and scarlatina maligna. It is not a very good division, but as it is generally adopted I will not depart from it.

Inflamed fauces make a part of the disease. Perhaps I can make you appreciate the value of this fact by a case. I was called over to Hoboken to see a child sick with scarlet fever, and when I got there I found the eruption clear enough—perfectly red all over the body. It had not observed, however, the order of beginning at the upper part of the body and spreading downward. I looked into the throat; it was as clean and natural as it ever is in a perfectly healthy child. I said to the doctor, "You have not a clear case of scarlet fever here. That cannot be scarlet fever; there is no sore throat." It turned out in a couple of days that the eruption died out. There was not much itching, and yet it was urticaria with as full an eruption as scarlet fever ever has. You observe my diagnosis was based upon absence of sore throat. I could not have distinguished between that eruption and that of scarlet fever, especially as scarlet fever eruption sometimes occurs upon the whole of the body at the same time.

There is always some inflammation of the throat in scarlet fever. The tonsils enlarged moderately, or considerably enlarged, as the case may be; the velum palati red and somewhat swollen. It may not be to an extent to give great inconvenience, but it is more certain to occur than an appreciable eruption. Then, as I am now speaking of the lesions, I may as well switch off and say to you that there are no lesions except these and sometimes swelling of the Peyerian glands in the small intestine, with a little tendency to elevation of the solitary glands. The rest is all visible during life, excepting the change in the blood, which is typhoid in its character.

In some instances the affection of the throat comes to be a very grave one. Indeed, you may say a fatal one, and to such cases the name scarlatina anginosa is applied. You will find sloughing of the throat in certain bad cases; the lymphatic glands that are near the surface will become swollen, sometimes suppurate. Sometimes there is hemorrhage into the swollen part. Such are always bad cases. Then as to the scarlatina maligna, the term partly applied to the "head" cases, and the head symptoms are not unfrequently preceded by convulsions. The convulsions in scarlet fever I think depend very much upon the condition of the blood in relation to its being purified of the albumen. My impression is, without having investigated the matter so thoroughly as to speak with authority, that the convulsive cases of scarlet fever are cases of albuminuria and uræmia, and yet this uræmia manifests itself in another way by a comatose condition.

You will occasionally see children in whom the eruption is far from being a bright red, like a boiled lobster, as it is sometimes said, but it will be almost a venous hue, a very dark hue. Then there may be hemorrhagic forms of the eruption, in which the skin will be darkened by ecchymosis. These are always bad cases. The dark eruptions are bad indications, and then with that are apt to go the head symptoms that I referred to. The child will sleep a great deal; will start up suddenly from sleep and scream, as in one form of meningitis; then fall back and be stupid, or perhaps be comatose. Those cases die early after the manifestation of these symptoms, and, as I have said, I think from uræmia. That is called scarlatina maligna.

There is another form of sore throat that is of a good deal of importance. I have seen two children in the same family die of that affection. It is diphtheria ingrafted upon the sore throat of scarlet fever. That condition has been known much longer than the term diphtheria has been used. That there can be a membranous inflammation of the throat I say has been long known, and that membrane forming upon the fauces is inclined to run downward into the air passages, and produce just the same symptoms as croup. These are the complications that occur in this disease, and the sore throat is manifest as early as the eruption, or earlier. Indeed, in scarlet fever and measles the eruption can be noticed upon the roof of the mouth before it appears on the surface of the body.

With reference to the duration of the eruption, it usually lasts upon the whole body one week; six to seven days, with or without the œdema that I have named. And the scarlet fever sore throat takes about the same time; or, if it is a bad sore throat, it will continue a good deal longer. A few days after the subsidence of the eruption there will occur a desquamation. It will begin, perhaps, about two days after the eruption has ceased, beginning first upon the part of the body upon which the eruption first manifested itself, and descending, little scaly exfoliations of the old epidermis. The action in the eruption of scarlet fever is sufficiently inflammatory to kill the epidermis, and as it dries up and a new epidermis forms underneath it, it is pushed off.

Occasionally the thick epidermis of the fingers, particularly of the palmar surface of the fingers, will exfoliate in one body, and it is said that the whole of the epidermis of the finger may exfoliate, appearing like the finger of a glove. I have never seen that, but I have seen the exfoliation of long ribbons on the palmar surface of the fingers, when the epidermis is thick and strong. In that respect scarlet fever differs from measles, the whole of the exfoliation in measles being of a fine, branny matter. You will always see this exfoliation of the epidermis if the child is not sweating a good deal. If he does sweat you will hardly see it; the sweat will cause the scales to adhere to the sheets of the bed in which he lies, and it may be, therefore, in a sense invisible.

There is, after scarlet fever, a very grave sequence, and that it is a part of the disease, I am led to suppose, because it is pretty uniform in the time of its appearance. About two weeks after the eruption has ceased, the child, running about the room, begins to be a little swollen under the eyes. The face becomes œdematous, the feet become swollen—indeed, there is a general moderate œdema. The child becomes very pale, but does not lose his vigor. He does not lose his fondness for play at once, but will run about; will run out of doors if you will let him. But after a while he may have a convulsion—a series of them. This œdema may last a very variable time, from a week to three, four, five months. But the greatest danger is during the first two weeks. I have tried, in certain instances, to confine the child to a temperature of 72° after scarlet fever, until the period of this sequela has passed, and I have not succeeded in protecting it. It does not occur in a majority of cases. It is rather an exceptional occurrence, but as it occurs at two weeks it would seem to have a definite relation to the eruptive disease.

* A lecture delivered by Alonzo Clark, M.D., LL.D., Professor of Principles and Practice of Medicine, College of Physicians and Surgeons, New York.

The mortality of scarlet fever is large. Different epidemics differ very much in their severity. We have had epidemics that would run on for a year or two in which there were very few deaths, not more than one in twenty or thirty, and I have heard a clergyman preach who left that morning, when he came to church, three dead children in his house. Some epidemics are fatal to about one-half of those who are attacked, and we never know in the beginning of an epidemic whether it is going to be particularly fatal or not.

Some physicians have encouraged their patients to expose their children to scarlet fever in the mild epidemics, to insure, as they say, a mild run of the fever. I do not know whether it is wise or not, because a great many children escape scarlet fever altogether. Hundreds of mothers have scarlet fever when their children have it, never having had it before.

With reference to the management of scarlet fever there is but little to be said. We cannot do much for it. If it be a mild case it will run a gentle course, and you have very little to do. If it be a bad case, it will have its bad features in spite of the best that you can do for it. I have sometimes thought that in the bad cases the best thing to do was just to let the child lie and take a certain amount of champagne, the quantity to be controlled by the pulse, and try nothing else.

In mild cases of scarlet fever, when the eruption appears, the fever diminishes in severity; in severe cases it increases, and the temperature may go up to 106°, 107°, and it is reported to have reached 111°. Of course such are bad cases. When adults have scarlet fever they are very apt to have little or no eruption but the febrile movement and the sore throat. The disease is a great deal more fatal in children than it is in grown-up persons. Grown-up persons usually bear it pretty well. Now and then you will hear of a person of mature age dying of it, but the greater number of them recover.

The redness of the eruption is produced by the congestion, an active congestion of the capillaries of the skin. You know they rise up in knuckles coming up and going directly down again, and it is these enlarged knuckles of the capillaries that make the separate points of the scarlet fever eruption. As I said to you, it is almost an inflammation, for there is frequently some œdematous effusion, and the cuticle is destroyed by the inflammatory action, so that it exfoliates in the manner that I have described.

There is a point of considerable importance which I omitted to state, and that is the effect of the sore throat upon the hearing. The inflammation of the throat occasionally affects the tubes that communicate with the middle ear, and the inflammation extends to this particular part, the result of which is, frequently, a loss of the tympanum. I once saw a little ring of bone ulcerate away, carrying the tympanum with it—a ring of bone out of the bones of the head, just large enough to hold the attachment of the tympanum, and the tympanum was unbroken. Of course that took some time to be accomplished. But the tympanum is often broken, and the bones of the ear are not unfrequently lost.

Dr. Pete, who for so many years had charge of the asylum for the deaf and dumb, wrote me a great many years ago for an explanation of the fact that in 1829 there was a very great increase in the number of deaf brought to that institution. The deafness was caused by scarlet fever, and he wanted to know what made scarlet fever so fatal to the hearing, and it is that that led me to read the statistics yesterday, showing that in 1829 more cases of scarlet fever occurred than from 1804 up to that time; and, of course, with an increased number of cases it would be reasonable to suppose that many of them were severe, and that the effect upon the hearing would be more markedly noticed. There is sometimes a complete deafness, which remains, of course, for life. Occasionally it is an impairment of the hearing of one ear, or of both ears.

I spoke to you of the period that elapses between the inception of the contagion and the development of symptoms. But another interesting point is, how long does the poison last in a person who has had scarlet fever? Very few observations have been made in regard to that. I have but one that is reliable, and that was in the practice of Dr. Cheeseman. He had a patient who had scarlet fever, and that patient had a little sister, I think younger than he. They were both children. The doctor told me that he had separated the two children; he had sent the well one to an aunt who had no young children in the house, and he wanted to know how long he should keep these two children apart—how soon the sister might visit her brother, having had a regular run of scarlet fever. I told him to keep them apart as long as he could, and he did succeed in keeping them separate for six weeks, and then the sister went home to the aunt's. The boy did not go home. The sister went down to the aunt's and took her dinner there, and the two children kissed each other, and in four days afterward the second child was attacked with scarlet fever. There was no other exposure known. If that observation was correct, why then here is a poison lingering in this person—in his clothes, in his hair, in his body, in his breath—we know not where, for a period of six weeks after he was attacked with the disease.

With reference to the treatment of this affection, I made a remark yesterday—and only one, because time did not allow me to make any more—that I often feel as if I may about as well not treat the case; to leave medicine entirely alone, and administer a moderate amount of champagne daily. I cannot tell you in an hour, it seems to me, the number of agents that are used for the sore throat. I have applied calomel; I have applied nitrate of silver; I have had children, when they were old enough, gargle with cold water frequently; and of these the cold water suits me best. But you cannot make use of it in a great many; they are not old enough to gargle. If there is a membranous production in the throat, I am very much attached to the spray of lime water. Take the lime water of the apothecary shop and put it into one of these little atomizers, or rather spray-producers; have the child's mouth opened, and throw the spray into the mouth when it is taking an inspiration, and let it go down into the fauces. If you can persuade him to let the mouth remain open with the tongue depressed, shower the fauces with the lime water. What he will swallow will do no harm.

In a case of regular diphtheria that I saw some time ago, this spray was used. The boy was old enough to have some discretion. It was used industriously, and within about six or seven hours the membrane exfoliated and came off whole. The boy was entirely relieved for several hours, and then began to have heavy breathing again. The spray was again used, and another membrane was coughed up, and again came rest and easy breathing and a diminished frequency of pulse; and this was repeated five times, and every time followed by expectoration or discharge of a whole membrane. It was not in fragments.

The sixth occurrence of this sort happened in the night, and the parents, though intelligent people, were persuaded that they could not stop the disease, and they allowed the boy to go on and suffocate. I do not know why the sixth formation might not have been discharged as well as the fifth, and if either of the physicians in attendance, Dr. Thomas being one, had had his way, he would have had the administration continued as long as the boy had any breath, if the membrane formed anew.

This same lime water, to be thrown upon the forming membrane, I believe is the most efficacious thing you may have. It does not apparently disintegrate the membrane, but it seems to produce a breaking up of its attachments to the living tissue.

We know a little something about the application of cold in scarlet fever. A physician of Connecticut, twenty years ago, came to this college and explained to me his treatment, and he was persuaded that it was more efficacious than any he had ever practiced before, and it was to use the wet sheet. Strip the body naked and wring a sheet out of cold water and spread it over the child, and allow the body to be cooled partly by the cold sheet and partly by the evaporation of the fluid that was in it and on his body.

It is perhaps five or six years since a very similar recommendation has come from Germany, and the bath is very much used in cases in which the temperature is very much elevated. The bath should be at a temperature of fifteen or twenty degrees below the temperature of the body, and the patient to remain in it until the thermometer indicates a marked fall in the temperature of his body. This does not seem in any instance to cause a recession of the eruption. The profession has been afraid of cold in scarlet fever, lest it should break up the regular course of the eruption; but it does not seem that that has been the result.

And here, with reference to the recession of the eruption, as we have but few definite facts with regard to it, I will read to you those that I have quoted from Levy, in his treatment of the young soldiers of France. He says, in the first place, "A recession of the eruption does not occur in more than one in a hundred cases; ninety-nine will run the regular course." But he has collected twenty-one instances of recession, and he says that in fourteen of these twenty-one there was no effect that could be observed. It was merely a recession and an end of the disease.

In one, sudamina appeared the next day—little minute blisters; two had slight diarrhea; one vomited the next day; in one varicella appeared two days after; in one tubercles followed at some distance of time subsequently. You see then that the recession is not so formidable a thing. The remark was, that we had been afraid of the application of cold, fearing the consequences of a recession of the eruption. But this Connecticut physician told me that he never saw it occur, and the German physicians seem to be trying the cold air upon their febrile eruptive diseases, so that we shall have more light on it before long, probably.

There may be recession and removal of the eruption, as in a case that occurred in Boston a few years ago, reported to me by the late Dr. Bartlett. Scarlet fever and measles were both in one family. There were three children. One of these children, that is the third, had scarlet fever; two had had scarlet fever and measles before the third child had scarlet fever. The eruption continued two days and receded, and immediately the eruption of measles took its place, or rather the symptoms of measles, and the eruption in time. The measles ran its course, and on the subsidence of the measle eruption, the scarlet fever eruption came again, and lasted three days, making five days for its duration in all, with an intermission of over a week.

These diseases, I may remark here, though it is a little out of place, seem to have great respect for one another. They do not run their course at the same time in the same person, but if the patient have been exposed to the contagion of both, the one that has precedence will run its course, and then the other will take its place.

I saw an instance of this that was quite remarkable. A child had diphtheria, and had been exposed to the poison of both scarlet fever and measles. The symptoms of scarlet fever appeared, and the membranous disease of the throat ceased. The scarlet fever ran its course, and measles appeared and ran its course. The child survived, and then the diphtheria appeared again and killed the child. It waited two weeks and more for these diseases to have their place and run their course, and then was revived; or, it was the result of the measles, which is not very common; or, it may have been a new infection, for that matter, I cannot say; but it did give place to scarlet fever and then to the measles, and then there was a renewal and a fatal result.

There are certain other things connected with this disease that require attention. When the scarlet fever eruption is of a black color, when there is hemorrhage under the cuticle, it is an evidence of a very bad state of the blood, a condition approaching that of scorbutus, and I have always advised just the same things that we would give in scorbutus—quinine and the vegetable acids pretty freely. When you have that immense swelling in the throat, and the swelling of the lymphatic glands outside, and a disposition to suppuration in these glands, and even hemorrhage, I do not know what to advise you to do. I have never done anything that did any good. Such cases I believe are predestined to be fatal.

I have something more hopeful to say regarding the sequela of which I spoke to you—the œdema. I was called into a family where there had been four children. Three of them had had scarlet fever. They went pretty easily through the scarlet fever. They were attacked with œdema, and in a few days had convulsions and died, one after another. There was but one child left, and that had scarlet fever, and the father and mother desired the family physician to get assistance. When this œdema occurred I immediately advised that the child be put in a warm bath; that he be kept in a warm room after being taken out of the bath and be kept in bed, and that enough clothes be kept upon him to keep him in a constant state of perspiration day after day.

You remember that there are casts and albumen in the urine in this condition. It is a kind of Bright's disease—an acute Bright's disease. The relations of the kidneys and skin are well known to you all. When the skin is chilled the kidneys act more vigorously; when the perspiration is free upon the suface the kidneys seem to act in a much more gentle way; and this suggested to me, first, the use of those means that will keep up a constant but gentle perspiration upon the surrace. This was done for many days and the child recovered. It had no convulsions.

I suppose that under the circumstances a portion of the urea is eliminated by the skin; indeed, I know it is, for I have not unfrequently perceived in those who had disease of the kidneys the odor of urine on the surface of the body and in the breath of the patient. At any rate, in practice, this seems to be by much the more successful mode of treatment. The bowels should be kept free, not purged vigorously, but a laxative should be given as often as seems to be necessary, and all the rest consists in an unirritating food, what of drink the patient wants, and this perspiration kept up.

There are many children who will not consent to lie in bed under these circumstances; they do not *feel* sick. If you meet such patients your alternative would be to dress them heavily in flannel, to keep their feet well clothed, and let them run about in the room, the temperature of which is kept steadily at 74° or 75°. In that way you can keep up a perspiration.

In regard to the deafness, one of the sequelæ, I have nothing to say about it. It depends upon disorganization that is the result, secondarily of the inflammation of the throat, and that, I have told you, I have not been able to treat with any very marked benefit. The best of all the means is gargling where the child is old enough, with cold water, or cold carbonic acid water.—*Medical Record.*

THE TREATMENT OF WHOOPING-COUGH WITH ATROPIA USED HYPODERMICALLY AND CARBOLIC-ACID INHALATIONS.

By WILLIAM LEE, M.D., late physician to the Baltimore General Dispensary.

IN August, 1879, having under my care a number of cases of whooping-cough, in some of which the paroxysms were unusually severe, I determined to try this plan of treatment, which, in part, I had shortly before seen highly recommended in *The Lancet* and in *The London Monthly Record*—the difference being, that I used the atropia hypodermically, instead of giving it by the mouth, as recommended in *The Lancet*. I did so because of my great faith in hypodermic medication; because the dose of atropia, which is unvarying in its strength, is easily regulated; and because the result of all investigation in regard to its action shows not only that cutaneous sensibility is rapidly lowered by it, but that at the same time an anæsthetic effect is produced upon the afferent branches of nerves which originate spasms.

Each minim of the solution used contained $\frac{1}{150}$ of a grain of atropia. I injected one minim or more, according to the patient's age, with 10 minims of water, always using it as early in the morning as possible, and repeating it at night if occasion required.

The carbolic-acid solution, of the strength of five per cent., made with the very best crystals, was used as follows: five strips of Canton flannel, three inches wide and five inches long, were saturated with this solution, and hung around the patient's bed and about the room at bedtime, and they were moistened with the solution once again during the night.

The result of the treatment in these cases justifies the belief, I think, that with it we may expect a steady diminution in the number and the duration of the paroxysms, a change in the character of the whoop, and a cure of the disease in a much shorter time than has been accomplished by any other means.

A few words as to the *modus operandi* of the treatment. Whooping-cough is a neurosis, and, to judge from the sensations described to us by those who are old enough to analyze their feelings, it is the laryngeal branches of the pneumogastric nerve that are primarily affected. The result of this affection is that at intervals a series of reflex phenomena present themselves, varying in duration and intensity, which involve nearly all the branches of the pneumogastric. The frequency of the paroxysms is, however, no index to their severity, and conversely; nevertheless, their frequency and intensity may be, and often are, coincident. Is there any explanation of this? I think so. No one who has much to do with the ailments of children can fail to observe what very different effects are produced in them by apparently the very same irritant. In one, convulsive movements, fever, restlessness, etc., are excited; while in another, and perhaps, of the same family, scarcely any systemic disturbance is the result. This is probably due to the inherent susceptibility of some children to "sympathetic" action and reflex phenomena; and, as nervous exaltation, or "nerve-tension," is far higher in children than in adults, we find in them, as a rule, a greater severity of the paroxysms of disease than is met with in adult life, and, according to idiosyncrasy, greater severity and greater consequent prostration in some children than in others.

Concerning reflex phenomena, Schroeder van der Kolk has shown that the medulla oblongata is the principal center whence the more general reflex movements derive their origin, it having a special capacity for exciting them; but in consequence of augmented irritation this capacity is greatly increased, and it will sometimes rise so high that reflex phenomena will manifest themselves spontaneously without further eccentric irritation. We can therefore understand how the peculiar irritation (which is probably excited at the periphery of the nerves which supply the larynx and trachea), having been transmitted to the medulla oblongata, calls forth those reflex actions which in their entirety constitute the phenomena of whooping-cough; and, further, if this irritation is constantly propagated, either through the action of a morbidly excited sympathetic nerve or from idiosyncrasy, the medulla oblongata may at length become so sensitive, of such exalted capacity, that severe reflex phenomena, even to the extent of convulsive action, may spontaneously arise. It is probable that in all cases of whooping-cough the degree of excitability capable of being produced in the medulla oblongata is the explanation of the various degrees of intensity in the reflex phenomena which we are so frequently called upon to witness; or, in other words, the intensity and frequency of the paroxysms of whooping-cough are in direct ratio to the amount of excitability to which the medulla oblongata is inherently liable.

Hence the treatment of whooping-cough should be directed primarily to diminishing this capacity for reflex excitability, either eccentric or centric. Of all drugs there are none that have such a peculiar and special effect upon the pneumogastric nerve as belladonna, though its action is by no means limited to that nerve. It is essentially a nervine sedative, and has the property of diminishing both sensibility and irritability when these are morbidly increased. Its primary effects are manifested upon the mouth and throat, producing thirst. A further action is upon the laryngeal muscles, rendering articulation imperfect, or preventing it altogether; also upon the constrictors of the pharynx, so that deglutition becomes difficult or impossible. These and other effects are produced in greater or less degree according to the amount taken. It is reasonable, then, to attribute the beneficial effects of atropia in whooping-cough chiefly to its action upon the laryngeal branches of the pneumogastric nerve, diminishing the exalted sensibility and

irritation which are known to exist, and which, by constant propagation to the medulla oblongata, increase in that body the capacity for reflex phenomena. But it is also probable that atropia has a very decided effect upon the medulla oblongata itself, rendering it less capable of exciting reflex action. Dr. Kloon's experiments led him to the conclusion that valerianate of atropia had a very special and direct effect upon it, diminishing its inherent capacity for reflex phenomena. The almost specific effect of belladonna in preventing nocturnal seminal emissions is also probably due to this action. I think, then, the conclusion is justified that, by its action upon the pneumogastric and sympathetic nerves and also upon the medulla oblongata, atropia relieves and ultimately cures the neurosis called whooping-cough; and that, in just those cases where, from idiosyncrasy or easily excited sympathetic action, the intensity and frequency of the seizures are greatest, its beneficial action will be most marked.

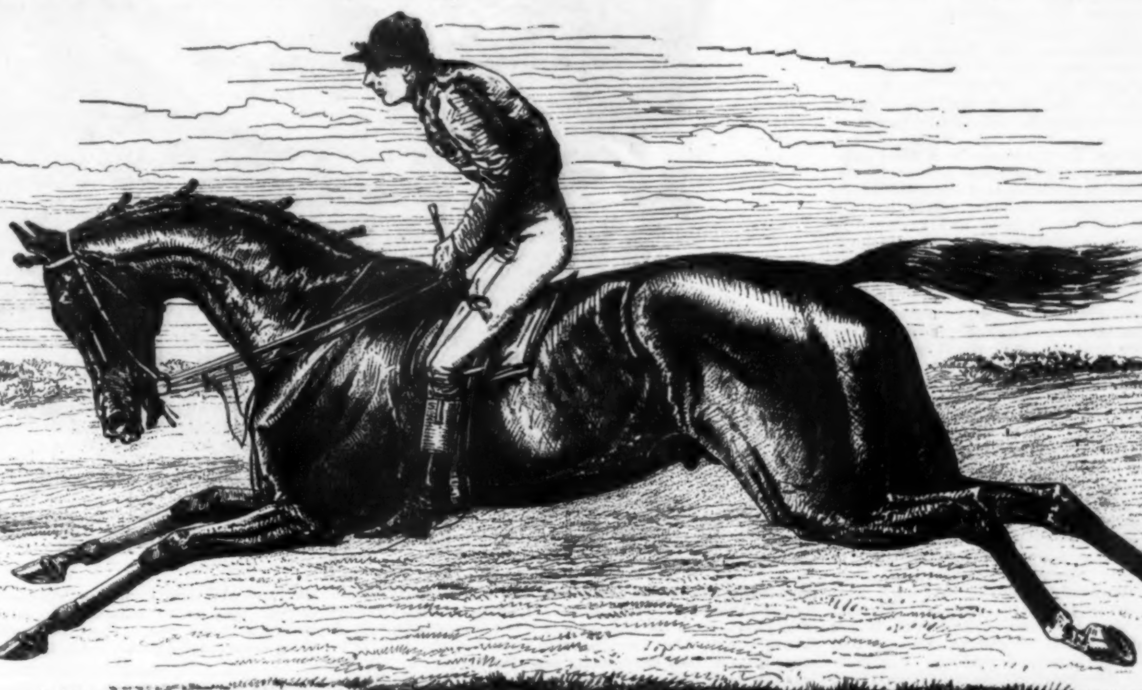
So much has been written about carbolic acid that I shall not attempt to explain the particular action it is supposed to exert in these cases. Suffice it to say that, as a result of my experience, I am satisfied that it not only acts as a direct disinfectant and purifier of the air breathed in these cases, but will also be found of service, used in the same way, even in other forms of cough.—*N. Y. Medical Journal.*

UNDULATORY NERVOUS ACTION.

ONE of the most recent theories of nervous action, deserving attention, is that the various peripheral expansions of sensitive nerves take up undulations or vibrations, and convert them into waves, capable of being propagated along nervous tissue. Thus, the same nerve tubule may be able to transmit along it vibrations differing in character, and hence give rise to different sensations; consequently the same nerve tubule may, in its normal condition, transmit the wave which produces the idea of simple contact, or that which produces the idea of heat; or, again, the same nerve tubules in the optic nerve which propagate the undulations of red, may also propagate, in normal vision, those which excite the idea of yellow or blue, and so for other senses.

THE WINNER OF THE DERBY, 1880.

IN many respects Bend Or's Derby must always rank as one of the most noteworthy on record. The course has never been so frightfully hard; in fact, the "going" in the Strand or Fleet Street would scarcely have been worse. Overhead, however, matters could not have been more pleasant, except that those whose business kept them constantly moving about in the rings, where something like 10,000 people had managed to pack themselves, found the weather a little more sultry than was quite desirable, and the attendance of the general public on the hillside, and in the various smaller stands, has probably never been equaled. The horse himself occupied a rather peculiar position. When accident deprived the luckless Beaudesert of the chance of competing, he stood out as incomparably the best two-year old performer of last season, his five victories being unsullied by a single defeat. The public naturally stuck to him stanchly week after week, but among racing men there was a general and very strong feeling against him. There is no doubt that one of his hocks was not quite what it should have been last season, and that the horse has not gone through the sort of preparation that usually precedes a victory in the greatest race of the year. Then be ran untried, and, though it was justly argued that there was nothing to try him with at Russley—indeed, that Peck had often to rely on a hunter, Blue Danube, to lead him in his work—this fact gave the members of the ring fresh courage to oppose him, and up to the very last two to one could be obtained against him, though, in his best form, it was odds on him. Bend Or, who was bred by his present owner, the Duke of Westminster, is by Doncaster from Rouge Rose, a daughter of Thormanby; and thus the Duke's purchase of Doncaster, for the unprecedented sum of 14,000 guineas, has already been richly repaid. He is a chestnut colt, standing very nearly sixteen hands high, though he is so thoroughly well proportioned and put together that he looks considerably smaller than he really is. His first appearance was in the Chesterfield Stakes, at the Newmarket July Meeting, which he won with great ease, in spite of the course being considered too short to show him to the greatest advantage. The Richmond Stakes at Goodwood was an equally easy prey to him; but, at York, it was agreed that Brotherhood fairly made him gallop to win the Prince of Wales's Stakes. Two successes at the Newmarket First October Meeting closed a very brilliant season, and fairly established him as the winter favorite for the Derby. This year he did not leave Russley until he journeyed to Epsom. The story of the "blue ribbon" was thoroughly told last week, and we have little to add to it. It has transpired, however, that Bend Or was shod on an American principle, with a layer of gutta-percha between the hoof and the shoe, this plan being tried with a view of lessening the tremendous concussion on the hard ground. In the course of the race he twisted the plate on his off fore foot, and this must have interfered with him considerably. The gameness he displayed in catching and beating Robert the Devil, after being apparently out of it at the distance, has never been excelled; and Archer, who never rode more desperately, had at one time given up all hope of success. Bend Or is in the Leger, and his many other rich engagements include three at Ascot, where he is likely to run if the ground is in a fit state for racing.—*Illustrated London News.*



BEND OR, THE WINNER OF THE DERBY.

DELAWARE EELS.

A CORRESPONDENT of the New York *Times* writes as follows: Any person who may stand on the bank of the Delaware River at the head of tidewater at this season of the year will see what at first sight appears to be a huge serpent moving up the stream near the shore. It is very black, and from eight to twelve inches through. If the spectator waits to see the end of the moving mass, he must remain on the shore for three or four days, for it will be that long in passing; and if he is not versed in the habits of fish, he will be surprised, upon investigating the character of this apparently endless line of life, to find that it is made up of diminutive eels, none of them more than two inches in length, many of them no larger around than a knitting-needle, and all so compactly crowded together as to form almost a solid body. They have just left the deep mud that forms the bottom of the river where the tide meets the water from above, and where they were deposited as spawn weeks before. They are on their way to the creeks and upper waters of the river, and by the time the smallest of them have gone one hundred miles on the way they will have attained a length of two or three inches, so rapidly do eel-fry grow. The compact form in which these young eels make their transit from the brackish water is retained until they reach the rapid upper waters, when they become more or less separated, and complete the journey in smaller schools. When they reach a point where a tributary stream enters the river, thousands leave the main body as if by prearrangement, and make their way up the smaller stream, while the great mass moves on up the river, until the draughts made by the quickly-recurring tributaries have reduced it to comparatively small proportions. During this strange journey the mass of eels is open to the attacks of marauding pickerel, black bass, and other ravenous inhabitants of the river, which lie in wait among the rocks and weeds along the shore and feed to repletion on the tender prey. A pickerel will dart out upon the eels from his hiding-place, and striking the moving body with his ponderous jaws wide open, pass clear through it, and fill his great mouth with eels at a single dash. A slight commotion in the wriggling army follows, but the next instant the ranks are intact again. The eel that was the size of a milliner's needle when it started out on its journey up the river will be nearly a foot and a half long and weigh a pound or more when he starts down stream in the fall.

In many of the creeks the young eels ascend from the river there are dams and high falls. The Sawkill Falls, near this village, is an obstacle they cannot overcome. They pass two high dams in some way in reaching the falls, and collect by the thousand at the foot of the cataract. They succeed in making their way up the precipice through the wet moss to a point near the top, where they are held in check by the rocks. At this season of the year moss may be torn at random from the rocks, and scores of little eels will be found wriggling about in every piece taken off. It is a novel sight to see them crawling up the face of the falls and watch them in their frantic efforts to get above the rocky obstacle at the top. Their efforts having never been followed by success, the creek above the falls contains no eels, while below the stream is alive with them. This is probably one reason why trout are so much more abundant in the Sawkill above the falls than below, as the eel is one of this game fish's worst enemies, and but for the wise dispensation of Providence that made the trout a winter-breeding fish and the eel to lie dormant in the winter, trout would long since have disappeared from the creeks accessible to the "slimy mud-born robber." The male eel is the greatest glutton and thief that swims, and the nests of fish that spawn in the spring are beset by no more destructive prowler than he.

But while eels are absent from the Sawkill and other creeks above the high falls upon them, it is a singular fact that they are found in other waters, above obstacles as great as those found in the Sawkill and kindred streams. The outlet of Metaque Pond, in Sullivan County, N. Y., and the stream running from Wescoline Pond, in this county, are noteworthy instances of this. On the former there is a perpendicular waterfall one hundred feet high. On the latter there are several dams, one of them a solid wall of stone, twenty feet in height. Yet, in both ponds eels of all sizes are very abundant. Naturalists assert that eels will not remain nor produce their kind in situations where they are unable to reach the sea and return. If that theory be true, how have eels existed in Metaque and Wescoline as long as any one can remember? If they possess the wonderful ability to leave these ponds in the fall and return again in the spring, why can they not surmount obstacles no greater in the other streams? And yet, no one ever saw any very small eels in the ponds, nor in any of the streams, save those that come up the river from the tide-water mud. Some years ago Sawkill Pond, at the head of the creek by that name, and possessing all the characteristics of other eel-possessing waters, was stocked with fourteen mature eels, with the hope that they would propagate and make the Sawkill as well known for its eels as Wescoline, Metaque, or other ponds in the region. But the experiment was unsuccessful. The eels that were placed in the pond were caught out with hook and line at different times during a series of years, but none have ever been taken or seen since. The failure of this experiment was generally accepted as satisfactorily settling the question of the necessity of salt water in eel propagation; but a contrary opinion is given by a gentleman who has for many years observed and studied the habits of fish in the Delaware—John G. Sawyer, of Sawmill Rift, Pike County.

"Naturalists have maintained for hundreds of years," says Mr. Sawyer, "that they have been unable to distinguish between the male and female eel, and that, like staminate and pistillate flowers, eels contain within themselves the elements of generation, which are only developed and matured by contact with salt water. It may seem like great assurance to say it, but it is a fact that what scientists have failed to discover is well known to every old fisherman along the Delaware. There is so much difference in the male and female eel that I can distinguish it in the dark, especially in the fall when they are running down stream. The male eel is very poor in the fall, while the female is round and plump. The male's head is much larger than the female's, and there is such a difference in the formation of the two that while you can grasp the male around the neck and prevent him slipping his head back through your hand, it is impossible for you to hold the female in that way. The male eel during the spring and summer and early fall is caught by angling in different ways—on 'bobs,' set lines, and the ordinary way of fishing—as he is very ravenous and continually seeking food. The female, on the contrary, will seldom take bait of any kind, and no food is found in her stomach.

She lies in deep, still water, while the male forages constantly about wherever his favorite food can be found. He despoils the nests of the simple shad, who lays her eggs on the sandbars and works them beneath the surface with her tail, and gorges himself on the spawn of his cousin, the lamprey, as well as that of every other fish that do not guard their nests. In fact, old fishermen say that the male eel is frequently so eager for the shad spawn that he will attack the female shad, big with her roe, put out her eyes, and then force an entrance into her stomach near the ventral fin, and devour her eggs. Shad caught in gill nets are often found thus mutilated and despoiled when the nets are taken up.

"Upon opening the female eel in the fall, a layer of what looks like fat, and which is called 'eel fat,' will be found along each side. This is her spawn. It forms in the fall, but is not ready for laying until the next spring. When the eels begin to run down the river the eggs are so small that it is impossible to discover them with the naked eye. Take a knife and press a piece of the spawn flat beneath the blade and the form of the eggs can be seen. They are of a creamy color, and look like the small particles of butter that first appear in the churn. There is also a fatty substance in the male eel, but its character is entirely different from that in the female. It lies close along the lower ribs. The eels begin to run down stream in September, and the fishing with weirs or racks formerly commenced. The law now prevents that means of fishing, and the eels have largely increased in numbers. The first catch of eels is always made up of those that were hatched in the spring, and which have grown to weigh a pound or so, and are fat as butter. When they have all passed down stream they are followed by the old female eels. These are the choicest of the season's catch, and run almost entirely unaccompanied by males, only a few of the latter finding their way into the racks while the former are passing down. Those that do run in are thrown out by the fishermen, and are called 'cullings.' After two or three weeks the males increase in numbers, and the females gradually disappear. Then the fishermen visit their racks no longer, or take them out entirely, as the male eels are not in condition for food. The eels are on their way to salt water, and while I believe that they seek the brackish water at the head of tide to deposit their spawn in the deep mud that lies there, I do not believe that it is a necessity for them to go there. If they were unable to get to that bed of mud, they would bury their spawn where they were forced to remain, provided the bottom of the river or pond was of a muddy character. If Sawkill Pond has a bottom of that nature, the eels that were placed in that pond to stock it must certainly have all been males, a circumstance that seems highly probable from the fact that they were subsequently caught on hooks. Female eels would not have been likely to bite on any bait. I know of two places where eels were propagated for years. One was on the stream that runs through my farm. There was a dam, into which it was absolutely impossible for eels to get from below. The creek is a natural water for eels. The bottom of the millpond became a deep bed of soft mud two or three years after the dam was built, and the pond rapidly increased with eels until it was an easy matter to take a washtub full at any time. The dam was carried away by a flood early one spring, years ago. In the mud that was left dry by the going out of the pond bushels and bushels of eels were found. This was weeks before the annual exodus of eels from below had begun. If the eels did not increase and multiply in that pond it would have been necessary for them to make a long journey on dry land to get into it from below. That all eels do not leave the upper waters of the river and seek the ocean in the fall is testified to by the fact that during ice freshets in the spring, eels are found in large numbers in the mud that is torn up from the bottom by the grinding of the ice. I remember one ice freshet that occurred in January. The ice formed a jam in the river below Port Jervis, and hundreds of eels were taken out of the *débris* in the jam. Eels are often found in excavating for coffer dams or canal locks buried in the mud, scores of them being turned and tangled together in one mass."

Mr. Sawyer says that in the lamprey eel, which is common in the Delaware and its branches, the sexes are as strongly marked as they are in the silver eel, and, consequently, the theory which has been advanced that the lamprey was the male eel is entirely without foundation. The river, he says, is filled with young silver eels before the lamprey begins to spawn. The female lamprey builds her nest in June, in the swift current. She makes an excavation sometimes two feet deep, frequently removing as much as a wheel-barrow load of stones in preparing the nest. She can attach her mouth to a stone by suction, and such is her strength that she will draw stones weighing five pounds and more from the bottom of the hole she is making. In removing a stone of this kind, she glues her mouth to it, and then works herself backward, and draws it after her. Mr. Sawyer says that he has speared lamprey eels that were so firmly attached in this way to a stone that he could lift the stone into his boat by taking the eel by the tail. The male silver eel hovers about the spot where the female lamprey is making her nest. After she deposits her spawn, she swims away to die, like the shad. The male eel feasts on her eggs. The lampreys that are hatched bury themselves in the sand along the shore, where they are found in the fall, two feet or so beneath the surface, by fishermen, who seek them as bait for other fish. Mr. Sawyer gives some curious information about the lamprey as a food fish, which will no doubt be interesting to the members of the Ichthyophagous Club. He says that if properly cooked it is considered a great delicacy by many people. It has no bones, and its flesh is of such peculiar character, that if a lamprey is laid in the sun it will gradually melt away like butter, until all that is left of it is a pool of grease. Notwithstanding this peculiarity, if the lamprey is placed in a pan to fry, the longer it fries the tougher it will get, until it is impossible for it to be masticated. The only way to render the lamprey eel edible is to cook it by stewing it over a very slow fire.

The appearance of eels in the Delaware in the spring is the signal for set-line fishing, and for "bobbing" for them. A set-line is either made of very heavy wire or large twine. It is stretched clear across the river at favorite points. At intervals of a few feet a "snood" is attached. A snood is a stout fishline, four or five feet in length, to which is fastened a strong medium-sized fishhook. These are baited with minnows or pieces of pork or clams in the spring, and with young lampreys and the "clipper" or "hojack," as the hideous larva of the helgramite is called. The set-line is put out at night. If the night is dark and stormy, without thunder, all the better. If there is thunder, eels will keep in their hiding places. The fisherman, if he watches his line all night, has a hut on the shore and a large fire in front of it. At intervals of an hour or so he goes over the line in his boat, taking hold of it near the shore and following it across the river. Every snood that has an eel on he unfastens from the line and places in his boat; for as soon as an eel is hooked it literally ties itself up in the line by knots and loops that no fisherman has ever learned to imitate, nor ever tried to disentangle until he has leisure on the shore. Lost baits are replaced, and new snoods put on in place of those taken off. Frequently a black bass of unusual size is captured. There is considerable excitement born of a trip over a set line on a favorable night, and the sport is very popular along the Delaware.

"Bobbin' for eels" is one of the angling diversions of the old time, and since the eel weirs have disappeared from the streams, is coming again into popularity. The sensitive angler would probably rather be excused from preparing the "lure" used in this style of fishing, as it consists in stringing with a needle a pint or so of wriggling fish-worms on a strong thread, and moulding them into a compact mass of thread and worms, as big as an ordinary man's fist. This squirming mass is fastened to the end of a long pole. At night the fisherman lowers the bob to the bottom of the river where eels most do congregate. The eel seizes the tempting bait at once, and signals his presence to the angler by a "thud" that ascends the pole to his hand like an electric shock. The eel's teeth are fastened in the tangle of thread and worms, and it either cannot or will not let go until it is safely landed in the boat. It was formerly no uncommon thing for a party of two or three to take a bushel of large eels from the Delaware in a few hours' bobbing. A favorite sport, when the eels begin to run in the fall, is to spear them as they move along near the shores, or lie still beneath the bright glare of the "jack." A three-tined iron spear, with barbed points on the tines, attached to a handle six feet long, and a large iron cage, mounted on a pole and filled with burning pine knots, comprise the outfit of a spearing expedition, unless the fishermen desire to push a boat along with them to put the eels in, and for easier return to their starting point. One person carries the jack so that it throws a bright light on the water, by which the bottom of the river is plainly shown in places even four feet deep. Another wields the spear. They wade in the stream near the shore. Eels seem to be attracted rather than alarmed by the light, and they are easily speared when seen, which is at almost every step. Eels were formerly so plentiful in the Delaware River and its tributaries that eel pots frequently burst with the numbers that ran into them, and it was no uncommon thing to take two thousand in a single rack in one night. Five years ago they had become scarce. Weir and pot fishing was then prohibited. Since then they have rapidly increased, and this spring some of the largest eels known in the river for years have been taken on set-lines.

HONEY WASPS AND THEIR NESTS.

As well known, the nests of wasps rival those of bees in ingenuity of construction; and some of these, especially those of tropical species, are very beautiful. The *Polistes nidulans*, for example, of Brazil and Guiana makes its nest of a beautiful polished, snow-white pasteboard, which is so solid as to defy the sun and rain of the tropics. It is suspended on the highest branches of the trees, swinging freely on the twig which passes through a sort of ring in the upper part, and entirely beyond the reach of monkeys, which would otherwise destroy it in the search of honey. Another species, likewise Brazilian, and which has been called by White the *Myroptera scutellaris*, constructs a very large bell-shaped nest, which is attached by its apex to a branch at about a foot above the earth. The nest is formed of several layers of thick pasteboard, and its surface, as shown in the accompanying engraving, is covered with a multitude of small conical points. The different entrances are sheltered from the sun and rain by projections which extend out over them, and they are also very tortuous so as to render the interior difficult of access to other insects. On opening one of these nests White found, in addition to a globular central mass, fourteen circular combs, some of them entire and others incomplete. Several of these combs had their cells filled with a brownish-red honey having hardly any taste or odor. D'Azara, who had resided in several portions of South America, had stated that several species of tropical wasps laid up honey like bees, but his assertion was denied, and he was accused of having mistaken bees for wasps. At the present time, however, the fact is known, beyond a doubt, that some wasps do, at certain periods, fill their cells with honey. Besides the two species just mentioned, another wasp, *Nectarinia analis*, is known to be a storer-up of honey; although the latter sometimes proves poisonous and produces on the person who eats it a sort of raving delirium. The large spherical nest of this wasp (shown in the engraving) is attached to climbing vines of the Brazilian forests at a few feet above the ground. Auguste de Saint-Hilaire tells us that having one day opened one of these vespiaries, near the Uruguay River, and with his two servants having eaten some of the honey it contained, he found it disagreeable to the taste. All three soon experienced evil effects from it, and thought they were poisoned. The honey had probably been gathered by the wasps from poisonous flowers; the same thing occasionally occurs with the honey of bees.

NESTS OF HONEY WASPS.

THE JARDIN D'ACCLIMATATION OF PARIS.

This beautiful garden, one of the most attractive places in the world, was established in the Bois de Boulogne in 1860. It was in the most flourishing condition at the time of the breaking out of the war with Germany. That war nearly ruined it. During the siege elephants and other valuable animals were sacrificed for food. The carrier-pigeons that did such noble service during the siege were mostly raised in this establishment, and those that survived the war are kept there and most tenderly preserved. "Many died gloriously on the field of honor," as we read in the records of the society, which preserve a full account of their wonderful feats. Some of them again and again dared the Prussian lines, carrying those precious microscopic dispatches photographed upon pellicles of collodion—so light that the whole one hundred and fifteen thousand received during the siege do not weigh over one gramme, a little over fifteen grains!

The great greenhouse of these gardens for plants that cannot endure a temperature lower than two degrees below zero centigrade (28·4° Fahrenheit) would enchant even the most indifferent observer. The building itself is one of the finest structures of its kind. It was once the property of the Lemichez Brothers, celebrated florists at Villiers, at which place it was known as the Palais des Flors. The Acclimatation Society purchased it in 1861, and every winter since then there has been a magnificent and unfailing display of flowers there. Masses of camellias, rhododendrons, azaleas, primroses, *bruyères*, pelargoniums, constantly succeed each other. These are merely to delight the visitors, the great object of the hot-house being to nurse foreign plants and experiment with them. Among the rare ones are the paper-plant of the *Aralia* family; the *Chamærops*, or hemp-plant; the *Phormium tenax*, or New Zealand flax; and the *Eucalyptus* of Australia, that wonderful tree introduced lately into Algeria, where it grows six meters a year, and yields more revenue than the cereals. This, at least, is what the official handbook of the garden says. It may be that the

famous "fever-plant" has lost some of the faith accorded to it at first.

At the end of this great greenhouse there is a beautiful grotto where a little brook loses itself playing hide-and-seek among the fronds of the maiden-hair and other lovely ferns. At the right of this grotto is a reading-room where visitors may find all the current periodicals—on the left, the library of the society, rich in works upon agriculture, *zootechnie*, natural history, travels, industrial and domestic economy, etc., in several languages. The remarkable thing about this great green-house is the ever-flourishing, ever-perfect condition of its vegetation. Of course this effect must be secured by succursal hot-houses, not always open to visitors. No tree, no plant, ever appears there in a sickly condition, but this may be said also of the animals in the gardens. I shall not soon forget a great wire canary cage some sixteen or more feet square, inclosing considerable shrubbery and scores of birds. There I received my first notion of the natural brilliancy of the plumage of these birds: its golden sheen literally dazzled the eyes.

The garden does excellent work for the French people besides furnishing a popular school and inimitable pleasure resort: it assures the preservation of approved varieties of fruits, grains, animals. Whoever questions the absolute purity of his stock, from a garden herb up to an Arabian steed, can place this beyond question by substituting those furnished by the Society of Acclimatation. Eggs of birds packed in its garden have safely crossed the Atlantic, seventy-five per cent. hatching on their arrival.* So immensely has the business of the society increased that more ground has had to be secured for nursery and seed-raising purposes, and the whole vast Zoological Gardens of Marseilles have been secured and turned into a "tender," as it were, to the Jardin d'Acclimatation at Paris. This was a very important acquisition. Marseilles, the great Mediterranean seaport of France, is necessarily the spot where treasures from Africa, Asia, and the South Sea Islands have to be landed, and they arrive often in a critical condition, and need rest and careful nursing before continuing their journey.

One of the functions of the garden is to restock parks with game when the pheasants, hares, wild-boars, deer, etc., become too rare for good sport: another is to tame and break to the harness certain animals counted unmanageable. The zebra is one of these. The society has succeeded perfectly in breaking the zebra and making him work in the field quite like a horse. An ostrich also allows itself to be harnessed to a small carriage and to draw two children in it over the garden. Still another work of the society is to breed new species. A very beautiful animal has been bred by crossing the wild-ass of Mongolia with the French variety.

Among the rare animals of the garden may be mentioned the apteryx, the only bird existing belonging to the same family as the *Dinornis giganteus* and the still larger *Epyornis maximus* of Madagascar—monstrous wingless birds now extinct. One of the eggs of the latter in a fossil condition is preserved in the museum of the Garden of Plants, in Paris. Its longer axis is sixteen inches, I think. It is, for an egg, a most wonderful thing, and on account of its size the bird laying it has been supposed to be of very much greater size than even the *Dinornis giganteus*, a perfect skeleton of which exists; but this seems to be a too hasty conclusion, for the apteryx, a member of the same family, has laid an egg or two in captivity, and one of these on being weighed proved to be very nearly one-fourth the whole weight of the bird, the bird weighing sixty ounces and the egg fourteen and a half.

The *Tallegalla lathami*, or brush-turkey of Australia, is another rare bird. It does not sit upon its eggs, but constructs a sort of hot-bed for them, which it watches during the whole term as assiduously as a wise florist does his seeds planted under glass or as a baker does his ovens. As in the ostrich family, it is the male that has the entire care of the family from the moment that the eggs are laid—a fairer division of labor than we see in most *ménages*. The interesting process of constructing the hot-bed has been observed several times in Europe. It is as follows: When the time arrives for the making of the nest the inclosure is supplied with sticks, leaves, and detritus of various kinds. The male then, with his tail to the center of the inclosure, commences with his powerful feet to throw up a mound of the materials furnished. To do this he walks around in a series of concentric circles. When the mound is about four feet high the female adds a few artistic touches by way of soothing down, evening the surface, and making a depression in the center, where the eggs in due time are laid in a circle, each with the point downward and no two in contact. The male tends this hot-bed most unweariedly. "A cylindrical opening is always maintained in the center of the circle"—no doubt for ventilation—and the male will often cover and uncover the eggs two or three times a day, according to the change of temperature. The observer, noting how intelligently this bird watches the temperature, almost expects to see him thrust a thermometer into his mound! On the second day after it is hatched the young bird leaves the nest, but returns to it in the afternoon, and is very cosily tucked up by his devoted papa.

One thing in the garden that used to greatly attract visitors was the Gaveuse Martin, a machine for cramming fowls in order to fatten them rapidly. The society considered Martin's invention of so much importance to the world that it granted him a building in the garden and permission to charge a special admission. The machine has since been introduced into the artificial egg-hatching establishment of Mr. Baker at Catskill-on-the-Hudson; at least, he has a machine for "forced feeding" which must greatly resemble Martin's. Specimens fattened by the Gaveuse Martin, all ready for the *broche*, used to be sold on the premises. The interior of the building was occupied by six gigantic *épinettes*, each holding two hundred birds. A windlass mounted upon a railroad enabled the operator (*gaveur*, from *gaver*, to cram, an inelegant term) very easily to raise himself to any story of the épinette. The latter was a cylinder turning upon its axis, and thus passing every bird in review. "An India-rubber tube introduced into the throat, accompanied by the pressure of the foot upon a pedal, makes the bird absorb its copious and succulent repast in the wink of an eye." Four hundred an hour have been thus fed by one operator. Fowls thus fattened are said to possess a delicacy of flavor entirely their own.—*M. H., in Lippincott's Magazine.*

VARIATIONS OF UREA IN CASES OF PHOSPHORIC POISONING.—At the outset of the experiments the daily secretion of urea was 15·66 grms.; it fell afterwards to 5·77 grms., rose again to 11·59, and sank finally to 0·20 grm. As the urea diminished in the urine it increased in the blood. The proportion of urea in the liver was also increased. The liver seems the principal focus for the production of urea.—*M. Thibaut.*

EXPERIMENTS IN THE USE OF LIQUID MANURE.

MR. T. BAINES, a well-known horticultural writer of England, favors the *Gardener's Chronicle* with the following valuable report of experiments in the use of liquid manure:

Some years ago I tried the effects of manure water made from manure of the various domestic animals—horses, cattle, and pigs—each kept separate and free of soaking from solid fæcal matter. I applied it to plants varied in their character, and ranging over most of the different subjects usually cultivated on farms and in gardens, outdoor as well as under glass. As a matter of course the extent of dilution was varied according to the natural ability of each kind of plant to take strong food. Things like rhubarb, celery, raspberries, black currants, chrysanthemums, mangel wurzel, and cabbage, as will be easily understood, grew vigorously with doses of a strength that would have destroyed slower growing things. I continued the experiment for several years to see what would be the effects on the plants, particularly such subjects as the black currants and raspberries, and in no case did I find any ill effects where the liquid was given in moderation, and never in a stronger state than the plants could bear. In all cases the urine was considerably stronger, and consequently required more dilution, when the animals were fed on dry food than when they had access to plenty of green stuff, as when out at grass, or with as many roots as they could consume. The relative strength stood thus—that of the horse first, pig second, and cow third.

But the strength alone was far from giving the true line as to their comparative manurial value, either for things of an animal nature, such as ordinary garden vegetables, or fruits, or pot plants, whether the latter are soft-wooded and quick-growing or hard wooded and of slow growth. With all, especially those of an enduring character, the cow urine told an unmistakable tale, not alone in the production of wood and foliage unequaled in vigor, but plants to which it was given exhibited a disposition to produce flowers in quantities that I have never seen result from the use of any other liquid fertilizer. Another important matter in the use of this urine is, that plants to which it is applied regularly for a number of years continue to make growth exceptionally strong without any indication of exhaustion such as invariably follows the use of manures that are only stimulative in their effects. This verdict I find is confirmed by several extensive plant growers whom I have advised to use it; but, like everything of a similar nature, being strong it must be used with caution—even for such subjects as chrysanthemums, it should be diluted to the extent of something like six or seven parts of water to one of urine, for weaker growing plants still further reduced, and, as with all liquid manures, only given when the plants are making growth.

At the time a plant is put out in the open ground, or placed in a pot or other confined space, solid manure, in quantity limited by its nature and strength, as also by the ability of the plant to absorb and assimilate food, more or less freely can be given; but beyond this we cannot go, as, if too much manure is present in the soil, its effects are identical with those which result from an animal taking food stronger than the digestive organs are able to digest and assimilate. It thus follows that, after a time, the manure first present within reach of the roots gets exhausted; it then becomes a question of providing more in either a solid or liquid state, the former usually in the shape of surface dressing, the latter by soaking the soil to which the roots are restricted. The use of solid manure, except in a highly concentrated state, is generally inconvenient for such plants as frequently most need assistance—that is when they have their roots confined in pots or similar appliances, with no access to food beyond the limited space in which they thus exist; it is then that manure water becomes the most convenient, and often the most beneficial in its effects, for in this way food is brought immediately within the reach of the whole number of the hungry mouths, the feeding fibers, quicker than by the use of solid matter laid on the surface, which takes time to get washed down in the ordinary process of watering.

There can be no question that the time of active growth in both root and branches, the spring and summer, is the proper season for using manure water; and where plants exist that want assistance in this way, especially such as are naturally of a hard wooded, enduring character, I should advise that in all cases some be given as soon as growth commences in either the roots or the shoots, otherwise the first efforts of the shoots will be weak, and no subsequent application of manure during the ensuing summer will in that case strengthen them so as to make the collective growth equal to what it would have been if the food they required had been within their reach at the time they began to grow. A matter requisite to keep in view is, that at the time when any plant is just in the height of its growth it will then bear manure water being given more freely than either in the beginning or later in the reason. Another thing of quite as much importance, and which those who are first commencing to grow any kind of plants will find it to their advantage to note, is, plants have not the power to reject the food that is brought in contact with their roots in the way that manure water is; whether the water they thus imbibe is sufficiently or overcharged with food, they must take it.

If it is too strong the effects are seen either sooner or later, but often when much mischief has been done. It is always well to keep on the safe side—frequent applications are very much preferable to stronger doses, even when they are only slightly too strong. As a rule, the slower the growth a plant naturally makes, the less able it is to bear manure water in a strong state. Through the absence of this fact being fully seen and acted upon, there are many plants that are generally supposed to be unable to bear manure water at all, such as the slowest-growing hard-wooded greenhouse plants, heaths in particular; yet it is in the case of these subjects, more even than stronger-rooted things, which can bear partial shaking out and a renewal of the soil, that assistance by the use of liquid manure is often most required. It is scarcely necessary to mention that whenever manure water is used, even to the most vigorous growing plant, which, consequent upon its strength, is able to bear that which would be death to others weaker, the liquid should always be clear and transparent, otherwise the sediment it contains is sure to clog up the soil, and make it too impervious to water afterwards.

NASCENT HYDROGEN.—A continuation of the author's discussion with Dr. Phipson. He maintains that nascent hydrogen is calorified hydrogen, and that all the reductions produced with nascent hydrogen may be obtained as well with ordinary hydrogen at an elevated temperature.—*Dr. Donato Tommasi.*

TUCKAHOE, OR INDIAN BREAD.

TUCKAHOE, or, as it is sometimes called, Indian bread and Indian loaf, is the name given by the aborigines to a curious subterranean production, which was long a puzzle to botanists, and the origin of which still rests in conjecture. It occurs in roundish masses, varying in size from that of a hen's egg to that of a man's head. The external rind or skin is very rugose and filled with cracks, and its color is ashy-black. The interior is a homogeneous whitish mass, of a starchy appearance and earthy odor, very firm, and which on drying cracks into irregular masses and becomes hard. It occurs from New Jersey southward to the Gulf of Mexico, and westward to Kansas. It is usually found at planting time, when it is turned up by the plow, and often gives no indication of having been attached to the roots of plants, although, occasionally, it has been found apparently parasitic. There is no mycelium found in connection with it, as there always is with fungi. It was first brought to the notice of the public by Dr. Clayton, who, under the supposition that it was a fungus belonging to the tribe of puff-balls, sent it to Gronovius under the name of *Lycoperdon solidum*, and, as such, described it in the Flora Virginica. This was about one hundred and forty years ago. Next it was described by Schweinitz, in his Synopsis of the Fungi of North Carolina, under the name of *Sclerotium cocos*, and by Fries, in his Systema Mycologicum, under the name of *Pachyma cocos*. At about the time Schweinitz described it, Dr. Macbride, of South Carolina, communicated to the Linnæan Society of London his own observations on the supposed fungus. The late Dr. Torrey, unaware of the fact that he had been anticipated by Schweinitz, described the production, about the year 1819, in the New York Repository, under the name of *Sclerotium giganteum*, and also published the results of a chemical analysis of it. Dr. Torrey ascertained that, while chemical tests failed to detect the presence of starch (which the microscope had also failed to show), the mass consisted almost entirely of a singular substance which he called sclerotine. Bracconot, some years after this, described the same principle (which, in some of its modifications, is the jelly of fruits) as pectine. Tuckahoe, possessing no cellular structure and no reproductive organs, was long ago removed from among the fungi, and is now considered by the Rev. M. J. Berkeley and others as a secondary product, caused by the degeneration of the tissues of some flowering plant, in which a change has occurred similar to that which converts animal tissues into adipocere; and that the cellulose and all other principles are transformed into a body of the pectose group. This, however, is conjecture merely, against the probable truth of which is the fact that no intermediate states have been found, while none, large or small, present any trace of plant structure. Owing to the fact that it is sometimes found attached to the roots of trees, especially those of the fir, Currey and Keller consider it to be an altered state of these occasioned by the presence of a fungus, the mycelium of which traverses, disintegrates, and even obliterates the bark. This view seems to be sustained by the analyses of R. T. Brown (1871) and J. L. Keller (1876). The former found it to be composed of water, 14 per cent.; glucose, 0·93 per cent.; gum, 2·63 per cent.; pectose, 64·45 per cent.; cellulose, 17·34 per cent.; ash, 0·16; and nitrogen only 0·36 per cent. Keller found 77·27 per cent. of pectose; 3·76 per cent. of cellulose; 3·64 per cent. of ash, and other things in about the same proportion as Brown did. From its chemical composition, Tuckahoe is very nutritious, and has long been used as an article of food by the Indians. It is also employed in the Southern States, boiled in milk, as a nutritious diet in diseases of the bowels, instead of arrowroot, and it has been recommended in a medical work as a starchy food, although it contains no starch whatever. A product, which is probably the same as tuckahoe, grows in China, and is sold as food in the streets of Shanghai under the name of fuh-ling. A full account of this is given by the Rev. M. J. Berkeley in the Proceedings of the Linnæan Society of London.

TUCKAHOE OR INDIAN BREAD.

NON-POISONOUS COLORS.—The following colors are officially sanctioned by the German Public Health Department for use in confectionery, etc.: For white, flour and starch; for red, cochineal, carmine, madder-red, and the juice of carrots and cherries; for yellow, saffron, safflower, and turmeric; for blue, indigo and litmus; green, juice of spinach and mixtures of the above blues and yellows; for brown, burnt sugar and Spanish juice, and for black, Indian ink.—*Reimann's Färber Zeitung.*

INTERMITTENCE OF PHOSPHORESCENCE IN FIRE-FLIES.

THERE has been an interesting discussion recently at the meetings of the London Entomological Society on this question, some members urging that the light is not intermittent, others again that it is. Mr. McLachlan drew attention to a previous discussion of the same subject, in the course of which he had suggested that the intermittence might be due to "slight currents of air altering the position of the insect when flying, and thus alternately exposing and obscuring the light producing surfaces." Judging from our experience with North American species of *Lampyridæ*, this explanation is not a valid one. All our American species, so far as we know, have the power of extinguishing their light, whether in flight, at rest, or in captivity. In flight there is no simultaneous flashing of all the individuals in a given space, but a constant and irregular flashing and extinguishing. In some cases there is a single flash followed by extinction; in others, two successive flashes, and in others again, three; and if pursued, the insect seems to have the power of suppressing its light.

These facts hold true of those species which are luminous, and have power of flight, in both sexes. Where, however, the female has not the power of flight the light is not intermittent, so far as our observations go, and the same holds true of the luminous larvæ of those species which, in the imago state, give out an intermittent light. Yet even these larvæ and larviform females possess the power of suppressing their light, as every one who has collected them must have experienced to his sorrow. A gem of soft blue light will attract the attention from some distance, in long grass, or damp places, such as these larvæ frequent. The collector approaches cautiously, but unless he is very wary, so soon as he touches the object upon or near which the light-giving specimen may rest, the light goes out, and the specimen very often escapes being captured!

DIGESTION OF FOOD BY THE HORSE WHEN AT WORK.

By E. V. WOLFF and others.

THE result of the experiments on the digestion of food by the horse, when performing different amounts of work, was that the digestion of food is not influenced by muscular exertion. Comparing the amount of matter assimilated during the digestion of various foods by the horse and sheep, the following facts are arrived at: The horse makes less use of hay than ruminants, the difference being 11–12 per cent.; but crude protein is equally digested in both horse and sheep. On the other hand, there is a wide difference as regards fiber, although the digestion of the non-nitrogenous extractive matter is more equal. Comparison of the digestive capacity for various kinds of hay shows that they are alike in both animals as regards the total organic matter; but as regards the various constituents, there is a difference, viz., with smaller absolute quantities of protein the difference is smaller; but in a few sorts which are difficult of digestion, the horse makes a better use of the protein than the sheep. There does not appear to be much difference between the digestibility of the fat and non-nitrogenous extract in either animal, but the opposite is the case as regards the fiber. Oats and beans and steeped maize are digested with like ease. Feeding the horse continuously with the same sort of hay appears to have no influence on the digestion of that food, whether it be given in large or in small quantities.—*Bied. Cent.*

A POMPEIAN HOUSE.

THE Naples correspondent of the *Daily News* writes: "The house which was begun to be excavated at the celebration of the centenary of Pompeii, and is, therefore, called 'Casa del Centenario,' and from which I then saw three skeletons dug out, has proved to be the largest hitherto discovered, and is of peculiar interest. It contains two atria, two triclinia, four alæ or wings, a calidarium, frigidarium, and tepidarium. It occupies the entire space between three streets, and most likely a fourth, which has yet to be excavated. The vestibule is elegantly decorated, and its mosaic pavement ornamented with the figure of a dolphin pursued by a sea-horse. In the first atrium, the walls of which are adorned with small theatrical scenes, the pavement is sunk and broken, as if by an earthquake, and there is a large hole through which one sees the cellar. The second atrium is very spacious with a handsome peristyle, the columns—white and red stucco—being twenty-six in number. In the center is a large marble basin, within the edge of which runs a narrow step. On the pedestal at one side was found the statuette of the Faun which I lately described. The most interesting place in the house is an inner court or room, on one side of which is the niche, with tiny marble steps, often to be seen in Pompeian houses. The frescoes on the walls are very beautiful. Close to the floor runs a wreath of leaves about a quarter of a yard wide, with alternately a lizard and a stork. Above it, about a yard distant, droop, as if from over a wall, large branches of vine or ivy and broad leaves like those of the tiger-lily—all very freely, naturally, and gracefully drawn. At each corner of the room a bird clings to one of these branches. Then comes a space—bordered at the top by another row of leaves—in which is represented a whole aquarium, as if the room were lined with tanks. There are different sorts of shells and aquatic plants lying at the bottom of the water, and swimming in or on it all kinds of fish, jelly-fish, sepias, ducks, and swans, admirably sketched with a light yet firm touch. The ripples made by the swimming ducks are indicated, and one duck is just flying into the water with a splash. On each side of the niche this amusing aquarium is enlivened by a special incident. To the left a large octopus has caught a monstrous murena (lamprey)—which turns round to bite—in its tentacles; to the right a fine lobster has pierced another murena through and through with its long, hard feelers, or horns. These creatures are painted in the natural colors very truthfully. On the left wall of the room, above the fishes, are two sphinxes, supporting on their heads square marble vases, on the brim of each of which sits a dove. Behind the niche, and on the left side of the room, runs a little gallery with a corridor underneath, lighted by small square holes in the border of hanging branches. The wall of this gallery behind the niche is decorated with a woodland landscape, in which, on one side is represented a bull running frantically away with a lion clinging to its haunches; on the other, a horse lying struggling on its back, attacked by a leopard; all nearly the size of life. On each side of the doorway is painted, respectively, a graceful doe and a bear. The other rooms are also very beautiful; one with a splendidly elegant design on a black ground; in another a small fresco representing a man pouring wine out of an amphora into a large vessel. The bath-rooms are large and elegant, the cold bath spacious and of marble. In one room a corner is dedicated to the *lares* and *penates*; and in the fresco decoration, among the usual serpents, etc., I noticed the singular figure of a Bacchus or Bacchante, entirely clothed with large grapes. In one of the mosaic pavements is a head of Medusa, the colors very bright and well preserved. As some of the rooms are only excavated to within two or three feet of the floor, it is possible that many valuable ornaments or statuettes may yet be found, as everything indicates that this splendid house belonged to some rich citizen."

THE EMMET COUNTY METEORITE.

PROF. J. LAWRENCE SMITH, who has been making an analysis of the Emmet County (Iowa) meteorite which fell May 10, 1879, states, in the current number of the *American Journal of Science and Arts*, that the fall of this body in all its attendant circumstances is one of the most remarkable on record. The place of fall is near Estherville, just on the boundary of the State of Minnesota, within that region of the United States which has become remarkable for falls of meteorites—the State of Iowa having become particularly conspicuous in recent years as the landing place of these celestial messengers. The phenomena attending the fall of the meteorite in question were of the usual character, but on a grander scale. It occurred about five o'clock in the afternoon, under a clear sky, with the sun shining brightly. In some places the meteorite was plainly visible in its passage through the air, and looked like a ball of fire with a long train of vapor or cloud of fire behind it; and one observer saw it 100 miles from where it fell. Its course was from northwest to southeast. The sounds produced in its course are referred to as being "terrible" and "indescribable," as scaring cattle and terrifying the people over an area many miles in diameter. At first they were louder than that of the largest artillery; and were followed by a rumbling noise like that made by a train of cars crossing a bridge. The concussion, when it struck the earth, was sensible to many persons, and it is reported that the soil was thrown into the air at the edge of a ravine where the largest masses fell. Besides this local disturbance of the earth, another remarkable fact is the depth to which the mass penetrated. The largest mass struck within 200 feet of a dwelling-house, at a spot where there was a hole (previously made) six feet deep and over twelve feet in diameter, having a bottom of stiff clay. The latter was excavated to a depth of eight feet before the meteorite was discovered. The second large mass was found embedded in blue clay about five feet below the surface, two miles distant from the first. The third of these largest masses was found at a locality four miles from the first; and this, too, was buried at a depth of five feet. The fragments thus far obtained weighed respectively 437, 170, 92½, 28, 10½, 4, and 2 pounds. In appearance the masses are rough and knotted like large mulberry calculi, with rounded protuberances projecting from the surface on every side, and which have sometimes a bright metallic appearance, showing them to consist of nodules of iron. They also contain large lumps of an olive-green mineral. The greater portion of the stony material is of a gray color, with this green mineral irregularly disseminated through it. When broken, one is immediately struck with the large *nodules* of metal among the gray and green stony substances, and some of which will weigh 100 grammes or more. In this respect this meteorite is unique, it differing entirely from the mixed meteorites of Pallas, Atacama, etc., or the known meteoritic stones, rich in iron; for in none of these has the iron this nodular character. The minerals found by Prof. Smith, on analysis, were olivine, troilite, chromite, bronzite, nickeliferous iron, and a silicate not yet well determined.

CARBONIC ACID IN THE AIR.—J. Reiset finds in 100,000 parts of atmospheric air, 29·78 parts by volume, the greatest differences observed only reaching hundred thousandths. The air in the night contained more carbonic acid than in the day. The maxima observed correspond to foggy weather. He has not detected any decrease in the proportion of carbonic acid as a weather indication.

NATIVE COTTON GOODS OF CHINA.

ONE of the best reports in respect to the native house-made cloths of China is that of the United States Consul at Amoy. The great mass of the people, Mr. Henderson says, the laboring classes of the interior, wear nothing but native homespun, and no doubt they have substantial reasons for preferring it to English cloth, even though it cost almost double what anything foreign they have seen ever does. If the looms of America or England can successfully imitate this cloth, or make as good an article with all its essential points, so that it could be sold in China at a lower figure, there is no reason why a trade should not be built up at the ports of Central China equal in extent to the present total importation of cotton piece goods. The homespun is manufactured wholly of native raw cotton, much of which is carried to Amoy and neighboring non-treaty ports in junks, so that no record is kept of the quantity imported. Although the threads are rough and uneven, they are composed of pure cotton, and possess great strength and durability—essential qualities in clothing for people who are constantly carrying some object or another on their shoulders. This kind is usually made by the women of the family for the use of their male relatives and themselves, and is now rarely found for sale in the larger market towns on the sea coast. It is woven in widths, varying from 15 inches to 25 inches. There is, however, a considerable quantity of cloth being now made in the cities, towns, and villages skirting the inner arms and shores of Amoy Harbor, which is composed of English or Indian yarn mixed with Shanghai cotton, the former being used for warp. There is in the minds of the people a peculiar virtue in Shanghai cotton. They claim that an equal weight of foreign cotton, spun and woven in the same manner, will not give as much warmth as Shanghai cotton. The latter is, therefore, mixed with the Indian or English yarn, which can be had much cheaper than the former can be made, in order to secure the desired warmth. This mixture has latterly, owing to its comparative cheapness, pretty well driven the homespun from the market, having left nothing but the very coarsest kinds. It seems to be mostly woven in pieces 21 inches wide by 28 feet long, containing just enough material for an ordinary Chinese jacket and trowsers. Except a limited number of people about the open ports, who have come to know and prefer the foreign article on account of its cheapness and better appearance, either native homespun or mixed cloth is worn by all classes at all times and for all purposes. For winter underclothing, one of these kinds is used by rich and poor alike throughout Central and Southern China, where no fires are kept, save the small baskets of charcoal carried about in the hands.

NORTH POLAR OBSERVATIONS.—A beginning is about to be made to carry out Lieut. Weyprecht's proposal for a circle of observing stations around the North Polar region. The Danish Government has resolved to establish a station at Upernivik, in West Greenland; the Russian Government has granted a subsidy for an observatory at the mouth of the Lena, and another on the new Siberian Islands; Count Wilczek is to defray the expenses of a station on Novaya Zemlya under the direction of Lieut. Weyprecht; the U. S. Signal Service under General Myer, has received permission to plant an observatory at Point Barrow, in Alaska; and it is expected that Canada will have a similar establishment on some point of her Arctic coast. At the Hamburg Conference it was announced that Holland would furnish the funds for a station in Spitzbergen; and it is expected that Norway will have an observing post on the extremity of the Province of Finmark.

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TABLE OF CONTENTS.